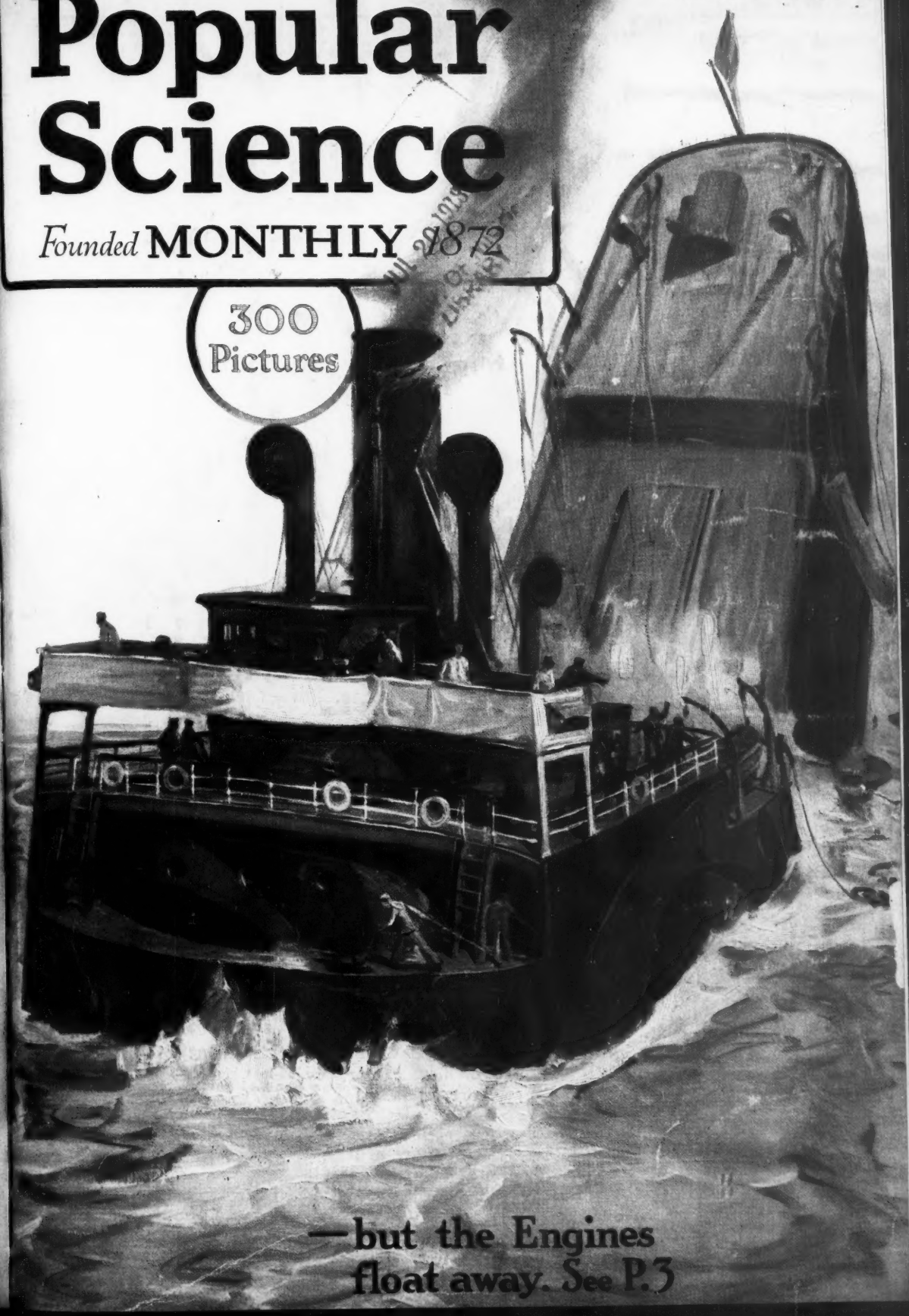
the magazine, and it will be placed in the hands of our soldiers or sailors destined to proceed overseas.

NO WRAPPING—NO ADDRESS

Popular Science

Founded 1872 MONTHLY

300 Pictures



—but the Engines float away. See P.3

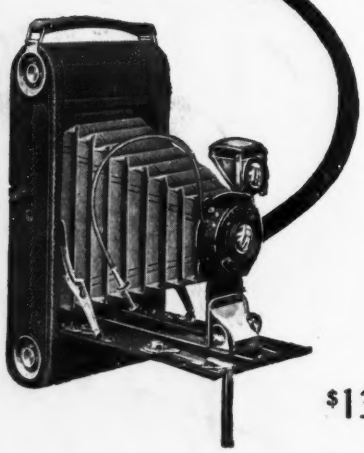
SENECA CAMERAS

ON the water and on land, the men in training or fighting are longing for pictures from home.

Get a Seneca and share the pleasures of your daily life, your outings and vacations. Happy pictures will be the most precious gifts you can send.

Ask your dealer or send for the free Seneca Catalog and choose the model that suits you.

Seneca Camera Mfg. Company
155 State Street Rochester, N. Y.



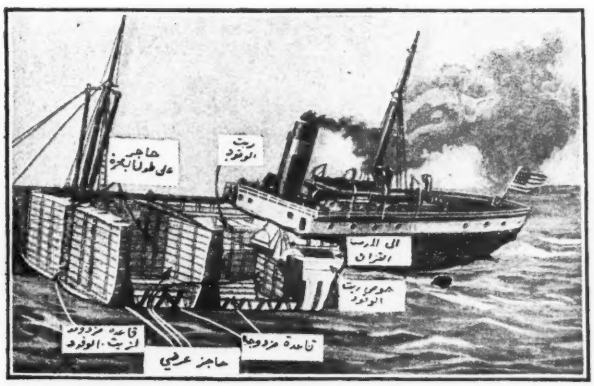
This 3A
Seneca Folding Scout
takes 3¼ x 5½ inch pictures just a trifle larger than the illustration above

$13

How We Look in Arabic

اخبار علمية وصناعية

﴿ سفن لا تخشى الطوربيد ﴾ طالعنا اخيراً بين اخبار الحرب أن الاميركيين شرعوا في انشاء سفن لا تخشى الطوربيد . وقد تساءل الكثيرون عن حقيقة هذا الخبر وشكوا في صحته . ومن حسن حظنا اننا اطلعنا على مقالة في احدى المجلات الاميركية فيها وصف لتلك السفن المراد انشاؤها وبيان موجز عن المبدأ الذي تبنى عليه فرأينا تلخيص ذلك في الهلال



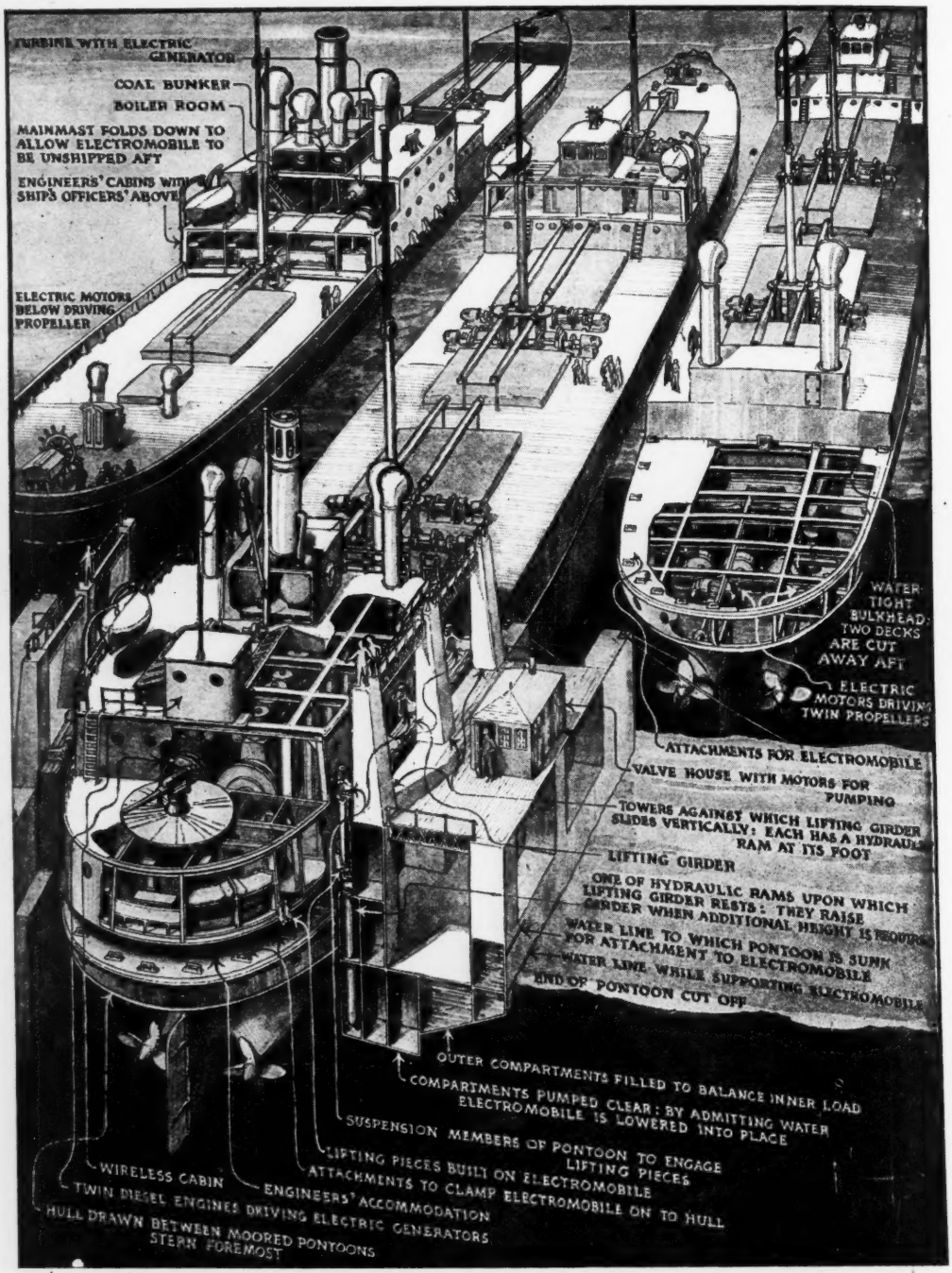
قطع خيالي في احدى السفن التي لا تخشى الطوربيد

لا يقصد من قولنا هذا ان تلك السفن لا يمكن اغراقها ابداً فانما هي لا تغرق اذا أصيبت بطوربيد واحد ولكنها اذا اصيبت بطوربيدين او اكثر في مواضع رئيسية فلا مناص من غرقها . وانما يتعذر ذلك على الغواصة لانها بعد اطلاق الطوربيد الاول لا يمكنها الصعود ثانية الى وجه الماء لاطلاق طوربيد ثانٍ من غير أن تتعرض لمدافع السفينة

وهذه السفن مبنية على مثال السفن الناقلة لزيوت الوقود . فان هذه السفن مقسومة الى احواض كثيرة يبلغ عددها ١٢ حوضاً او اكثر بواسطة حاجز منيع على طول السفينة

"Al Hilal" is a scientific and literary review published in Cairo, Egypt. Recently it republished an article of ours on the Donnelly wooden ship. We thought it might interest our readers to see how we look in Arabic; and so we have reproduced in facsimile the first page of Al Hilal's rendering of our article. An Arabic friend tells us that Al Hilal is edited by George Zaidan. Alas! George has not given us credit.

Changing the Engines


TURBINE WITH ELECTRIC GENERATOR
COAL BUNKER
BOILER ROOM
MAINMAST FOLDS DOWN TO ALLOW ELECTROMOBILE TO BE UNSHIPPED AFT
ENGINEERS' CABINS WITH SHIP'S OFFICERS' ABOVE
ELECTRIC MOTORS BELOW DRIVING PROPELLER
WATER-TIGHT BULKHEAD: TWO DECKS ARE CUT AWAY AFT
ELECTRIC MOTORS DRIVING TWIN PROPELLERS
ATTACHMENTS FOR ELECTROMOBILE
VALVE HOUSE WITH MOTORS FOR PUMPING
TOWERS AGAINST WHICH LIFTING GIRDER SLIDES VERTICALLY: EACH HAS A HYDRAULIC RAM AT ITS FOOT
LIFTING GIRDER
ONE OF HYDRAULIC RAMS UPON WHICH LIFTING GIRDER RESTS: THEY RAISE GIRDER WHEN ADDITIONAL HEIGHT IS REQUIRED
WATER LINE TO WHICH PONTOON IS SUNK FOR ATTACHMENT TO ELECTROMOBILE
WATER LINE WHILE SUPPORTING ELECTROMOBILE
END OF PONTOON CUT OFF
OUTER COMPARTMENTS FILLED TO BALANCE INNER LOAD
COMPARTMENTS PUMPED CLEAR: BY ADMITTING WATER ELECTROMOBILE IS LOWERED INTO PLACE
SUSPENSION MEMBERS OF PONTOON TO ENGAGE LIFTING PIECES
LIFTING PIECES BUILT ON ELECTROMOBILE
ATTACHMENTS TO CLAMP ELECTROMOBILE ON TO HULL
ENGINEERS' ACCOMMODATION
WIRELESS CABIN
TWIN DIESEL ENGINES DRIVING ELECTRIC GENERATORS
HULL DRAWN BETWEEN MOORED PONTOONS STERN FOREMOST

An English engineer, H. de M. Snell, suggests that much of the time and therefore the money now lost by holding a ship in port for several days in order to unload and take on cargo, might be saved if detachable powerplants were used. By means of pontoons, he would lift an engine-containing hull from a newly arrived vessel and drop it in one ready to depart. The actual lifting is done by means of hydraulic rams on the pontoons. The engine-hull is water-tight and is therefore able to float. If the ship should be torpedoed it would be easy to unhook the engine-hull so that it could float off in safety in the manner shown by our cover design. This engine-hull may also be placed amidships

Popular Science Monthly

225 West Thirty-ninth Street, New York City

Vol. 93
No. 1

July, 1918

$1.50
Annually

Changing Engines Like a Suit

How H. de M. Snell would use detachable power plants to reduce the expense of loading a vessel and how his plan would help to save lives at sea

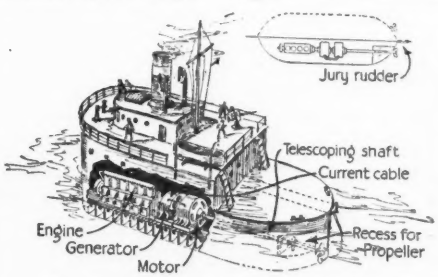
By Joseph Brinker

THE *Great Eastern* was the most daring experiment in shipbuilding made in the nineteenth century. She was a financial failure. Why? Not because she was too big for her time, but because her time was inefficient. The wharves of our ports had no adequate means for loading and unloading so huge a hull; no adequate means for collecting enough freight in a short period. And so she would be held in New York for weeks, waiting for a cargo big enough to fill her capacious hold. Thousands and thousands of dollars were lost each trip by enforced idleness.

Ships are no longer held in port for weeks. Hence the *Great Eastern's* financial failure is not repeated. But for all that there is still costly delay. Every time a ship ties up for two or three days to load and unload, its idle powerplant is an investment which is not paying full dividends.

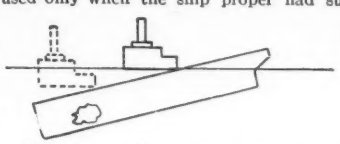
To eliminate this economic waste H. de M. Snell, a British engineer, has made a daring suggestion. He would use an electric powerplant which can be kept in continuous operation by the simple expedient of taking it from one ship as soon as it enters port to unload and installing it in another loaded ship ready to leave port. This principle is original in ship construction, yet very old in other forms of transportation, as for instance the railroad with its detachable powerplant in the form of the giant steam locomotive and its long train of freight cars which can be loaded or unloaded while the locomotive is busy elsewhere earning dividends by actually moving goods. Why not apply the same principle to a ship? Why should a ship's costly powerplant be kept idle while she is loading and unloading, simply because the ship travels in water and the locomotive on land? In effect, Mr. Snell would make a freight car out of a cargo ship.

He accomplishes this result by mounting a portion of the ship's powerplant consisting of twin Diesel engines and electric generators in a flat-bottomed, tight hull which may be set down on the upper deck of the boat, either amidships or at the stern, and held rigidly in place by means of clamps. The Diesel engines drive electric generators, the current from which is carried by means of cables to electric motors far down in the hull of the vessel. The motors drive twin propellers through gearing. Both motors and propellers are fixtures; they are not removed with the generating powerplant, the break in the connection between the two being made in the current-carrying cable from



The Engine Hull Floating by Itself

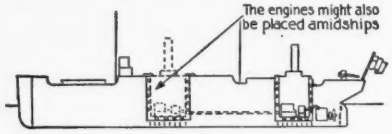
The detachable watertight engine-containing hull could be made self-propelling as here shown. The motors and propellers would be supplied. The propellers would be carried on telescoping shafts and used only when the ship proper had sunk



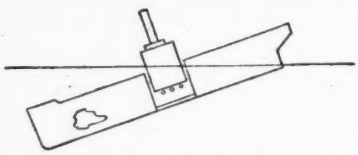
The dotted lines show how the powerplant hull would float off when the ship is torpedoed

the generators to the electric motors.

And now let us suppose that a steamship constructed as Mr. Snell conceives enters New York. What happens? Two pontoons with lifting girders range themselves on either side of the ship. By means of powerful hydraulic hoists the hull containing the engines is lifted bodily. Very much the same principle is followed in raising much heavier submarine boats into their "mother" ships. The pontoons transfer the suspended engine-containing hull to a waiting loaded ship, and drop it into place.



Snell intends to place the engines at the stern, but as the dotted lines show they might also be placed amidships



How the engines amidships would float off when the ship is torpedoed

Mr. Snell's system has an advantage which should not be overlooked. The engine-hull is water-tight; therefore, it is able to float. Suppose the ship were to be torpedoed, it would be no difficult matter to unhook the hull so that it could float off in safety in the manner shown by our cover design. Mr. Snell has not supplied independent propellers for his engine-containing hull, although he has supplied quarters for the crew. We have, therefore, shown in one of the accompanying drawings, how the powerplants can be made self-propelling. It would be necessary merely to add two motors and two propellers, the propellers to be carried on telescoping shafts and to be used only when the ship proper has sunk. At other times they would be carried in small recesses in the powerplant hull, so that they would not interfere with transference from one ship to another.

To go a step further and overcome any objections which might be raised against placing such a large deadweight as a heavy powerplant on the upper deck of a vessel and making it top heavy when no cargo is carried, it would seem possible to insert the hull carrying the generating powerplant, whether located at the stern or amidships, entirely within the ship proper by placing smaller roller wheels at the front and rear and the bottom of the inserted hull.

Mr. Snell's idea discloses a vista of great possibilities. The system he proposes may be improved and developed along practical lines. The engine-hull will, in course of time, be transferred from one ship to another with scientific precision and mathematical accuracy.

Motor Trucks May Be Equipped with Pneumatic Tire

"WILL you have it sent by railroad or motor truck freight?" This is the question that may be asked of shippers as a result of the use of pneumatic instead of solid tires for automobile trucks. The prediction that the truck may become a competitor of the railroads is based on the fact that the pneumatic tire takes away the limits as regards speed that were imposed on the truck by the solid rubber band.

Pneumatic tires were formerly restricted as to size, but this limit no longer prevails, provided laminated cords without cross weaves are used instead of woven fabric. These cords stand strains without difficulty. The speed and the distance traveled by vehicles equipped with pneumatic tires have been increased and the upkeep costs reduced. Trucks with pneumatic tires can be operated through sand, mud and snow, where solid tired vehicles would be stalled.

Pneumatic tires like that shown in this photograph may now be used for trucks

On account of the growing demand for more transportation facilities due to war conditions anything that will enable the heavy motor truck to keep down expense and add to its speed and the distance it can travel will be welcome.

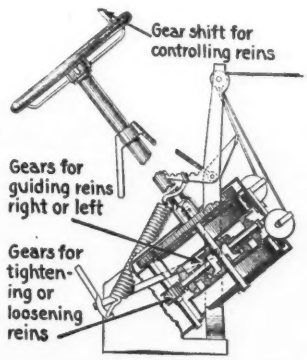
Here's the Near-Auto—as Near As a Horse Can Be One

THE honors for the first attempt to modernize quadrupeds will go to Lynn S. Pace, located in the progressive town of Cisco, Utah. Incidentally ground has been broken in a new field of invention.

Horse, auto, 50-50. This is the basis of Lynn's invention. He argues that it is not necessary to hold the reins in your hands when you drive a horse. The reins could just as well be wound around a pair of drums controlled by a steering-wheel—such as you see on automobiles. The wheel is connected to a gear mechanism which is actuated to simultaneously rotate the above mentioned drums in opposite directions to tauten the reins, and both in the same direction to wind one of the reins while the other rein is unwound.

Such an attachment will furnish you with all the pleasures of driving an automobile minus the attendant dangers.

One might suggest a few improvements which would greatly enhance the value of Mr. Lynn's device. For instance, let a crank be inserted in the horse's chest, which you turn a few times before you start out on your near-auto spin. The horse could also be trained to "honk" at street crossings.



Let your imagination revel in this make-believe auto! Why buy a limousine when a horse does as well?

Poor teacher is having her troubles in giving these triplets their right names and telling one from another

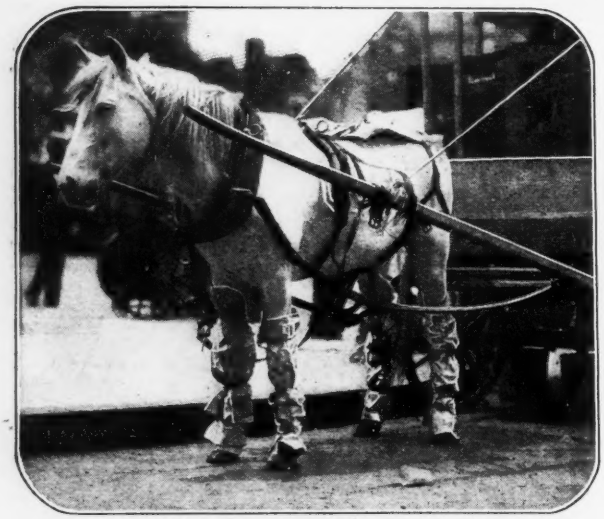
Which Is Gertrude, Which Is Grace and Which Is Genevieve?

ALIKE even to the last freckle on their noses, the Wildey sisters, of Oak Park, Illinois, present a continuous problem to their teacher, and even to their mother—not to mention prospective difficulties for the young men who, a few years hence, will be paying them attentions and will be unable to make an intelligent choice.

The three girls, Gertrude, Grace, and Genevieve, are eleven years old. So far they have missed only half a day of school, but as all were absent at the same time the teacher was not perplexed. It is not recorded that any of the triplets ever acted any differently from the other two.

The three girls dress alike, walk alike, talk alike, study alike, and get grades alike—perhaps because the harassed teacher quits trying to figure out which is which and lumps their work together.

There is sure to be an interesting future for these pretty triplets.



Makeshift stockings made of newspapers to protect the horse's legs from the flies that annoy in summer

Newspaper Used as Socks for Horses. They Keep the Flies from Biting

HORSES often suffer acutely from the annoyance of flies. Not only during the day, but often during the night the stamp, stamp, stamp which is heard in the stables tells the story of faithful animals unable to rest on account of the pestering insects.

The owner of the horse shown in the accompanying illustration resorted to the expedient of wrapping newspapers around the animal's legs. This undoubtedly served the purpose, but only the horse could decide whether the heat from the paper was less hard to endure than the annoyance of the flies. No doubt the newspaper shade over the animal's back was appreciated, since it kept off the sun and did not keep out the air.

Another lover of horses uses the sleeves of discarded shirts to protect the horses' legs, just like stockings.

Stockings made of cheese cloth have often been similarly used.

Keeping Musicians' Hands in Trim with Finger Stretcher

A SIMPLE device for accelerating the progress of a musician in mastering his instrument has recently been invented by Kanute I. Finney of Chicago, Ill. Such well-known soloists as Jascha Heifetz, Godowsky, Eddy Brown and Jacques Thibaud have utilized the device to keep their hands in their accustomed flexible condition on tour, when it was not practicable to spend the customary time at practise on an instrument.

The device consists of a frame with eyes through which are run cords attached to soft pads, four in number. Against each pad one finger may be placed and the hand then moved from a straight, open position to a curved, closed position to flex the muscles and accustom the fingers to long stretches, or to keep them in condition if used by an artist whose hand is perfectly trained.

The felt pads are adjustable. It is necessary merely to loosen or tighten the silk cord which encircles the metal frame to accomplish the adjustment. The device weighs less than three ounces and can be easily carried in the pocket. It can be used to advantage not only by violinists and pianists, but even by typists who desire to acquire speed more rapidly than by following the usual methods of practice.

The accompanying illustration shows the contrivance in operation. The four fingers are imprisoned in the soft pads which are easily adjusted by loosening or tightening the silk cord which runs outside of the frame. All you have to do is to work your hand to get desired result.

The finger stretcher will not enable you to rival Paderewski; but it will help some.

This finger stretcher will keep your digits flexible and supple—in condition to play

Spectacles That Furnish Their Own Light

L. ZACHARA, of Bremerton, Wash., was often hampered in his occupation by the lack of proper light. He wanted light on the object on which he was working. No shadows should interfere with clear vision. On the other hand, his eyes had to be protected from its direct rays. So he hit upon the expedient of attaching to the spectacle frame one or more electric filament lamps which are supplied with electricity from a battery or an ordinary lighting circuit. Wide frames of an opaque material protect the eyes from the direct rays of the incandescent lamp. This lamp is located between the eyes or set in the rim surrounding the eye, as shown in the accompanying illustration.

Spectacles whose attached lights are shaded from the eyes and thrown on objects

Reading the Meter from the Outside

ALL the inconvenience that results when the meter reader finds nobody at home or rings the bell and calls the housewife away from her work is eliminated by a new type of meter box which is so placed that the meter may be read without entering the house at all. The device also eliminates the necessity for a flash light, and for climbing inconvenient places to be able to read the dials. The number of readings that may be made by one man is increased a hundred per cent. or more. The meter may also be "blocked" or sealed when a tenant moves, or tested when desirable. Although the meter can be read by anybody at any time, it cannot be tampered with. Its adoption will be a great advantage to gas companies.

This meter saves both time and annoyance to the busy housewife

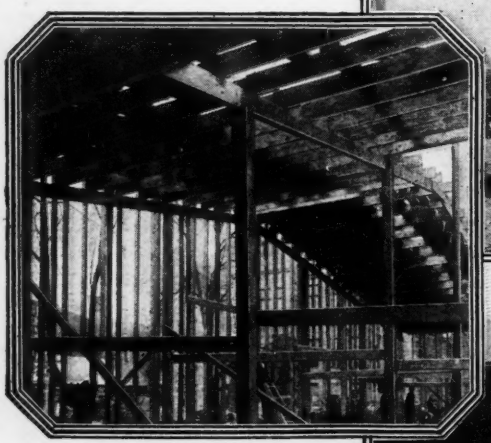
How the British "Tanks" Received Their Name

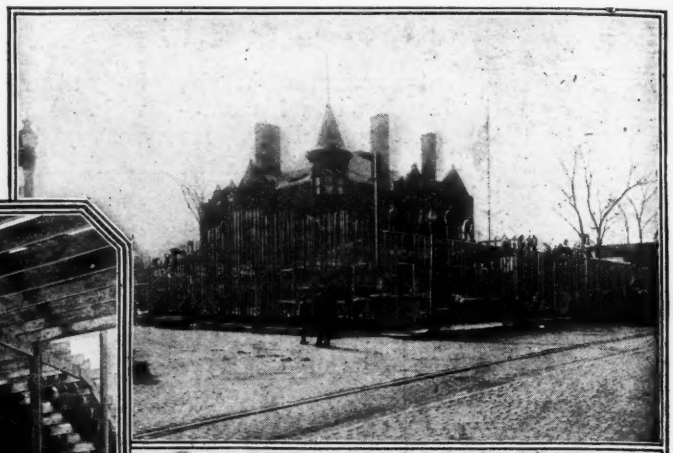
BECAUSE a fellow of the Royal Historical Society has unintentionally misled the British public, as to the origin of the famous "tanks," Sir William Tritton, who designed and built them, has published the real story of their name. It seems that in the early days of the war, Sir William Tritton's firm made some tractors for hauling heavy howitzers. Admiral Bacon, then Managing Director of the Coventry Ordnance Works, expressed regret that they would not cross trenches. That made Sir William think. He thought with such success that he produced a tractor known as "Little Willie." Since it was obviously inadvisable to herald "Little Willie's" reason for existence to the world, he was known as the "Instructional Demonstration Unit." "Little Willie's" hull was called in the shop orders a "water carrier for Mesopotamia;" no one knew that the hull was intended to be mounted on a truck. Naturally, the water carrier began to be called a "tank." So the name came to be used by managers and foremen of the shop, until now it has a place in the army vocabulary and will probably be so known in history for all time.

How Liberty Hall, a $15,000 Structure in Hammond,

After Two Hours

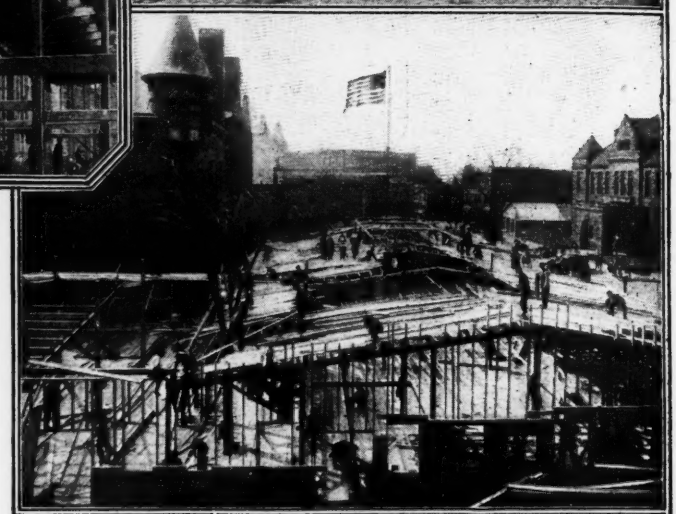
At nine o'clock the studding was nearly all up, some of the rafters were in place and a start had been made in putting on the sheeting





What System Will Do

The 225 workingmen, who built Liberty Hall, were organized in units of nine men each. This picture shows what one of the units had accomplished by 8:30 o'clock



At the Turn of the L

This shows the junction of the two sides of the L at 10 o'clock. The flooring was nearly all down, the sheeting more than half in place and siding on two sides half way up

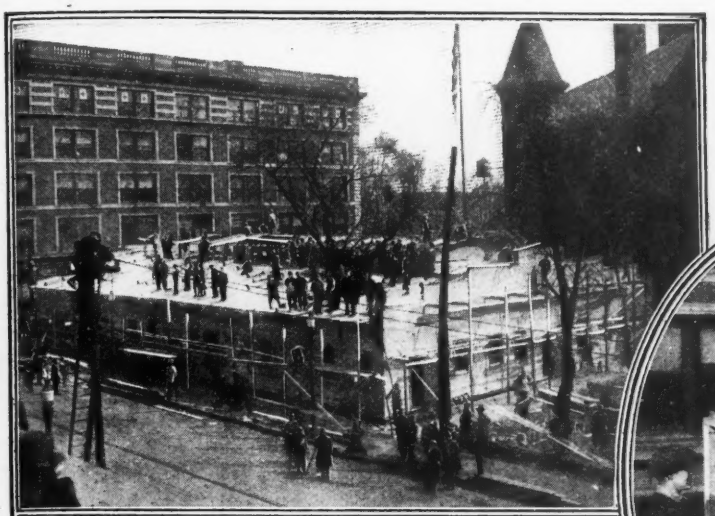
A Double Door Unit

Two carpenters putting the finishing touches on a double door unit. This unit, when carried to the building, was permanently put in place hinged and screwed on in less than five minutes

Making Rapid Progress

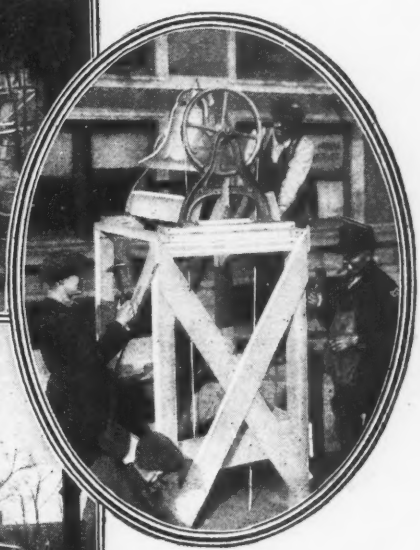
This interior view, taken at 11 o'clock, shows in the background the studding going up for the stage. The sheeting is nearly all on, and many of the doors and windows set up in their frames and securely fixed

Ind., Was Completely Built in A Single Day



Ahead of the Schedule

At noon the work on the building was 1½ hours ahead of the schedule. The siding was practically all on, doors and windows in place and work on the roof was progressing rapidly



Liberty Bell in Place

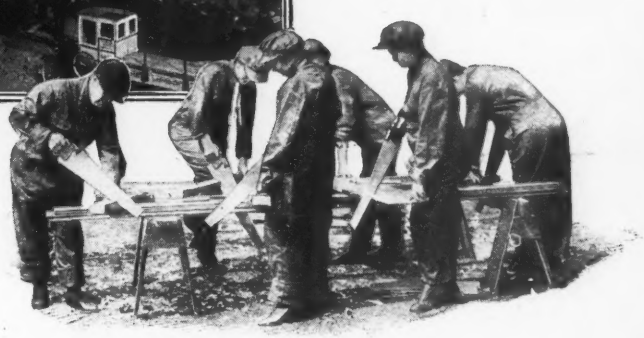
When the building was completed the Liberty Bell shown here proclaimed this fact to the people. On the evening of that day, March 3, 1918, a dance was given in the building

Busy as a Bee Hive

At two o'clock the roof was practically complete, the painters were half done with their work and the interior work was making rapid progress. The hall was filled with busy workers

Nearing the End

At half past three the outside was practically completed. The scaffolding was taken down and the cupola was finished—ready for the Liberty Bell



Patriotic "Lady Carpenters"

A unit composed of six women carpenters assisted in building the hall and subscribed for a $50.00 Liberty Bond

Reproducing the France in Minia- How Sculptor and Represent War's

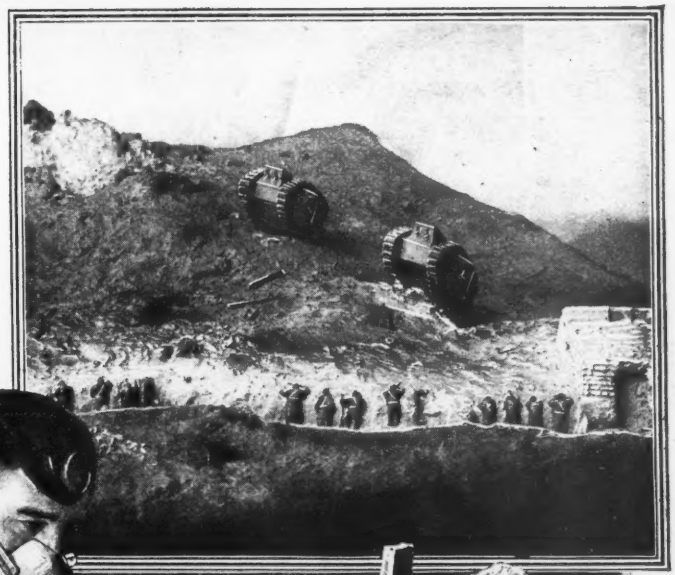
This photograph shows one stage of the making of models, a number of them being placed against a wall to allow the plaster to dry. The sculptor is adding details which were incomplete in the original mold—putting a finishing touch here and there

Photos © Brown and Dawson

The sculptor is here pictured reproducing in miniature a cathedral as it appeared after it had been bombarded by German guns. The latest photographs taken of the ruins were placed at the disposal of the sculptor so that the work might be correct in all the essential particulars

No effort is spared to make the models realistic. After a miniature representation in plaster of the cathedral ruins had been completed a smoke torch was actually applied in order to produce the charming effect of the Teutonic shells

Battlefields of ture Models— Artist Work to Devastation

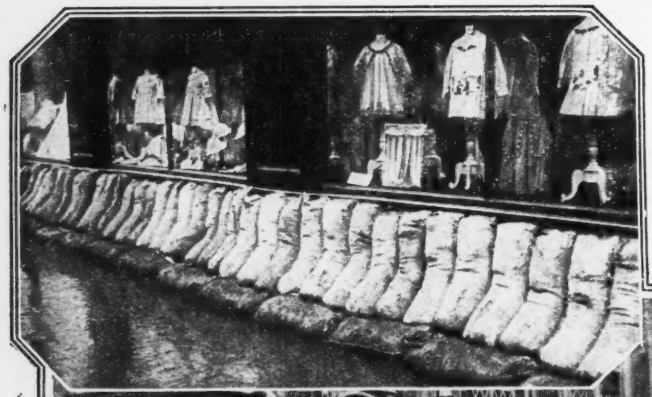


This model illustrates a battlefield in the Aisne sector with British tanks advancing across No Man's Land to lead the attack on Germans in the trenches in the foreground. The sculptor has even gone to the pains to reproduce small objects on the ground

This is the manner in which red brick coloring is applied to the white plaster model of a cathedral partly demolished by German shells. In order to produce the desired effect it is necessary to use an air brush as shown. The operator wears a gas mask so as not to inhale the spray of paint

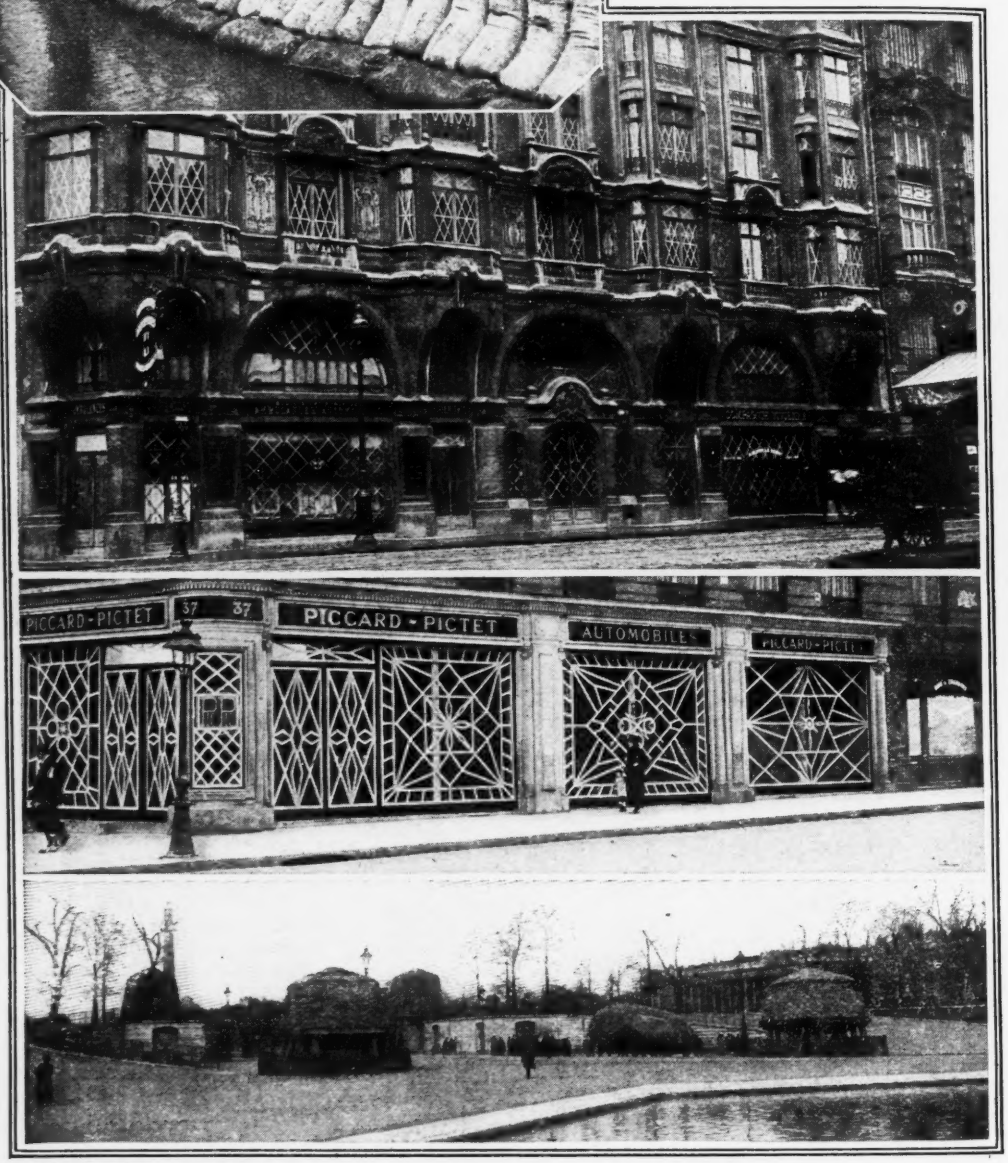
Twenty thousand cars a day is the output of the automobile department of the model factory. These automobiles are modeled exactly after the various types of Liberty trucks. An artist paints them a gray color to make them conform with machines which served as models

How Paris Protects Itself from Air Raiders



These sand bags were placed before the windows of cellars where residents of the city sought refuge from the bombs and shells

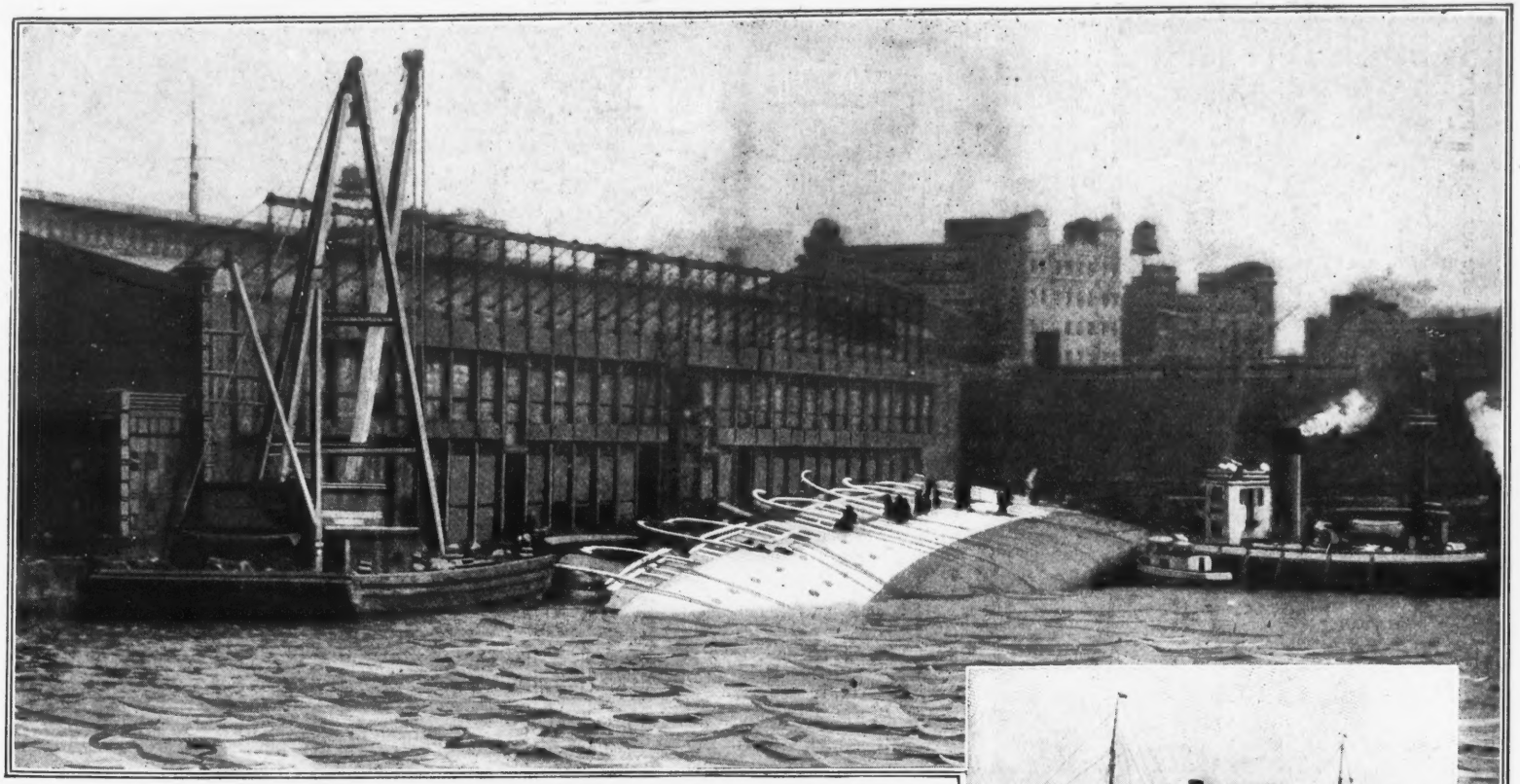
The concussion from the shells is terrific. Strips of paper are placed on the windows to prevent breaking glass from doing harm

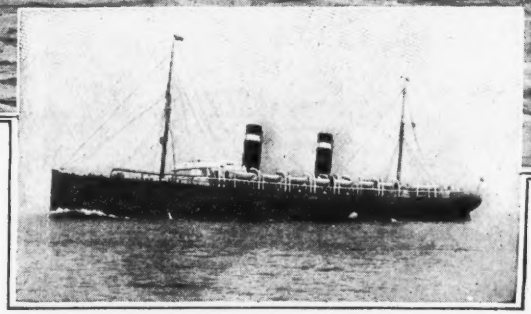


Photos © Kadel and Herbert

Above is shown an example of elaborate paper stripping protection for windows
Below are pictured statues and pavilions shielded by sand bags from the shells

She Sank At Her Pier



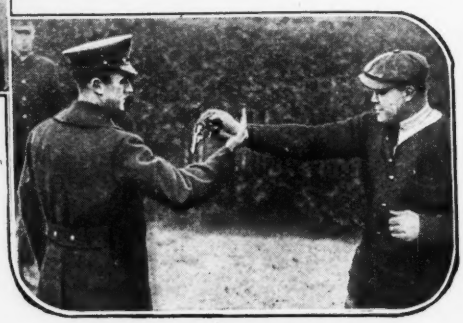


The American liner St. Paul turned over on her side when she sank at her pier in the Hudson River, New York City. Here she rested so that it was possible for persons to walk about on that part of the sunken vessel projecting above the surface of the water

The vessel was riding high out of the water, her ballast having been removed, which made her difficult to handle. One version of the accident attributes the sinking to an open ash port which, when the ship listed, permitted the water to flow into her hold

How Philadelphia "Strong-Arm" Policemen Are Trained to Cope with "Criminals and Gangsters Who Resist Them

If the gun is discharged by accident in the struggle for its possession it will hit the gunman



A quick and sharp blow on the wrist with the edge of the hand will make the crook drop his gun

In a rush one may be tripped, another clubbed and the third disabled by the "strong-arm" officer of the law

A class of policemen practising hammer lock, wrist hoist and disarming methods in the open field. They are also taught the armhold on refractory prisoners or other malefactors

The Policemen Are Given a Regular Practical Course in Jiu Jitsu of a Modified Form by Competent Instructors in the Art

Bending the wrist in this fashion forces the criminal to open his hand and drop his knife

This method of throwing the attacking criminal over the shoulder looks easier than it is

If the push under the chin is hard enough it may break the gangster's neck

Practising the gentle art of twisting the refractory criminal's arm behind his back and locking them there until he becomes reasonable and tractable makes them experts in time

Charming the Snake in the Occident and the Orient

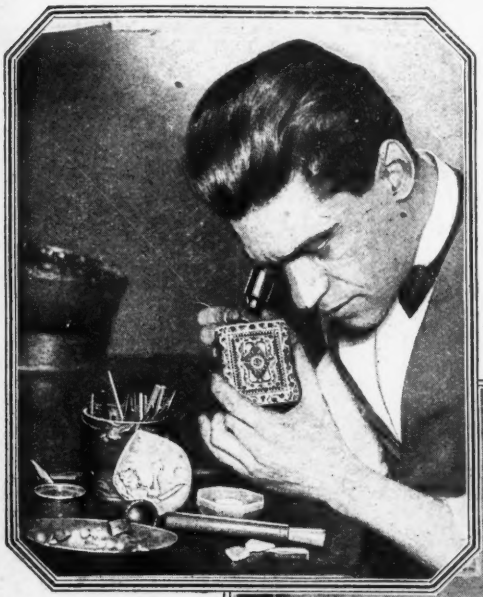
Photos © Brown and Dawson

This is a snake charmer of Trinidad, caught by the camera man in a typical, natural pose

The West Indian snake charmer visits the gardens of hotels and entertains tourists with performances by his wriggling protegés

These Hindu snake charmers are compelling reptiles to dance in front of a hotel in Lucknow, India, to the music of a flute which can be seen in the hands of one of the men in the photograph

Refashioning Gold, Silver and Brass into Things of Great Beauty and Utility



To shape this bowl, the metal craftsman, Ladislas Emeric Zental, shown in the picture, had to hammer the heated metal for many hours on the small anvil before him

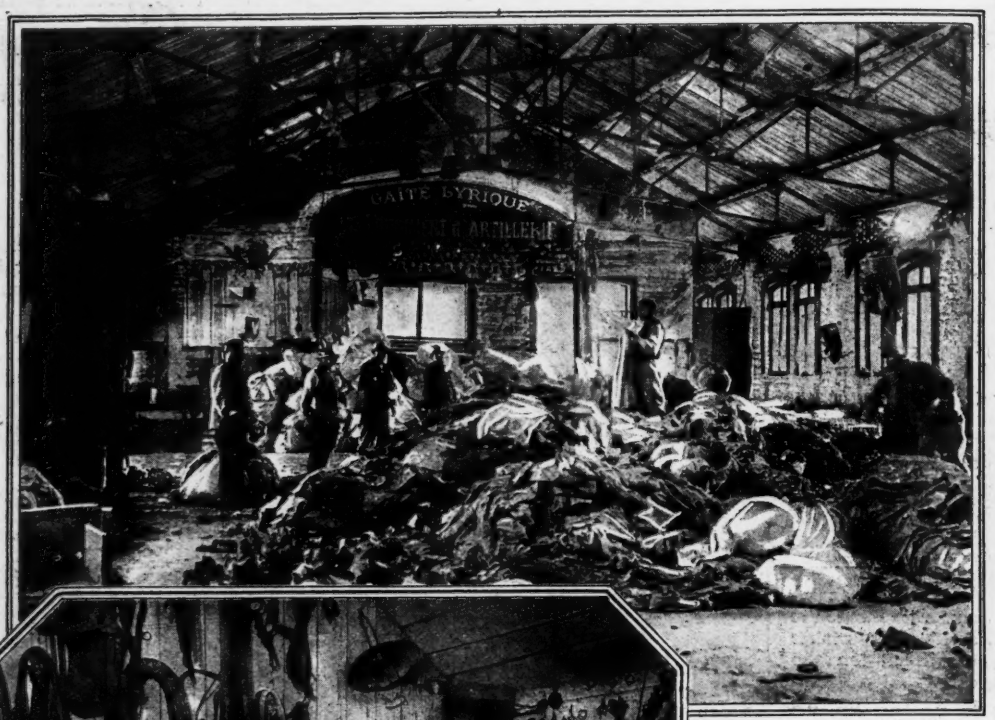
To make this enameled cigaret case the artist first makes the design on the case. Then he applies the enamel in paste form and fuses it into place

The metal is being heated by the flame of a gas blast in order to make it soft so that it can be worked into shape. The shaping is done by hammering

Working on a carved group, "The Lovers," forming the top of an ivory and silver comb of great beauty. The artist rests his work upon a sand-filled cushion block

In chasing designs upon metal the artist places the object he is working on upon a sealing wax block which gives just the right backing, firm but not too rigid

War Efficiency in France Makes the Most of



The Lyric Theater, Verdun, is a junk shop where discarded articles of wearing apparel are accumulated to be patched into shape again

French Official Photos

The most efficient care is constantly taken in repairing bridles, collars and other parts of a harness

Coats made of sheepskins are being worn by soldiers in the trenches. These men are sorting sheepskins for shipment

Every Waste—from Shoes to Shell Cases

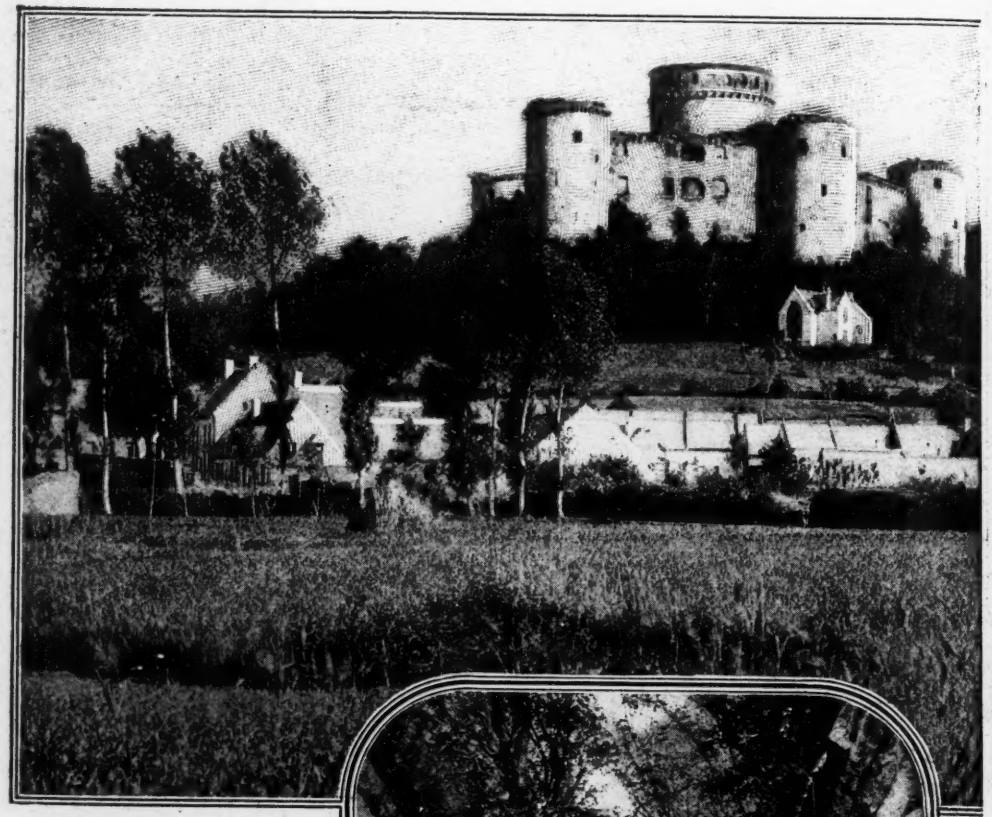
Damaged shells are sent to repair shops behind the firing lines and then to munition factories for reloading and recapping

Trench helmets, damaged by long use in the rough life of the soldier so as to seem almost beyond repair, are made over again by the patriotic, willing women workers

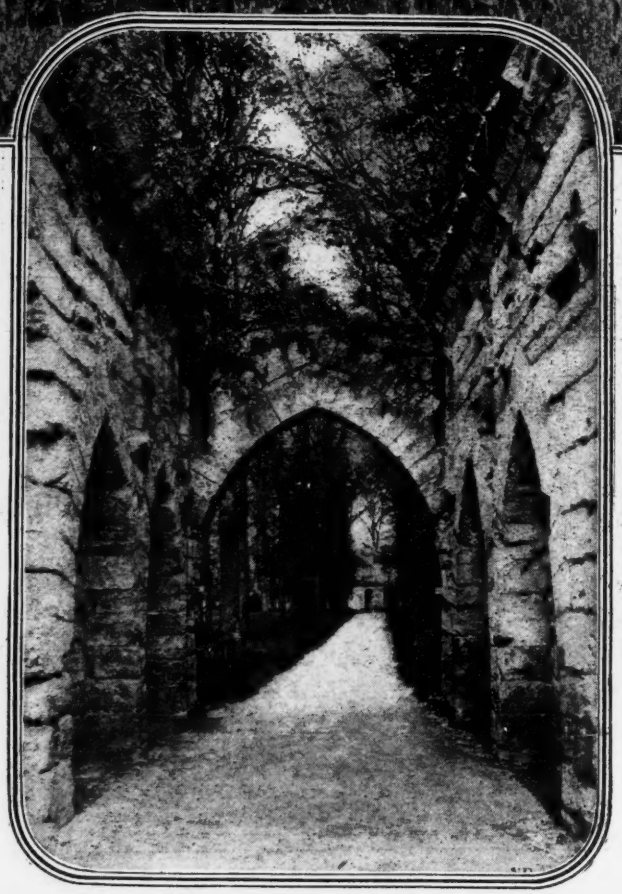
Even the soldiers' kitchen ware has not escaped the wave of economy. Old women work energetically to mend mess pots and pans

No opportunity is lost to utilize old clothes for making caps for the fighting men at the front

Before and After Von Hindenburg Visited the

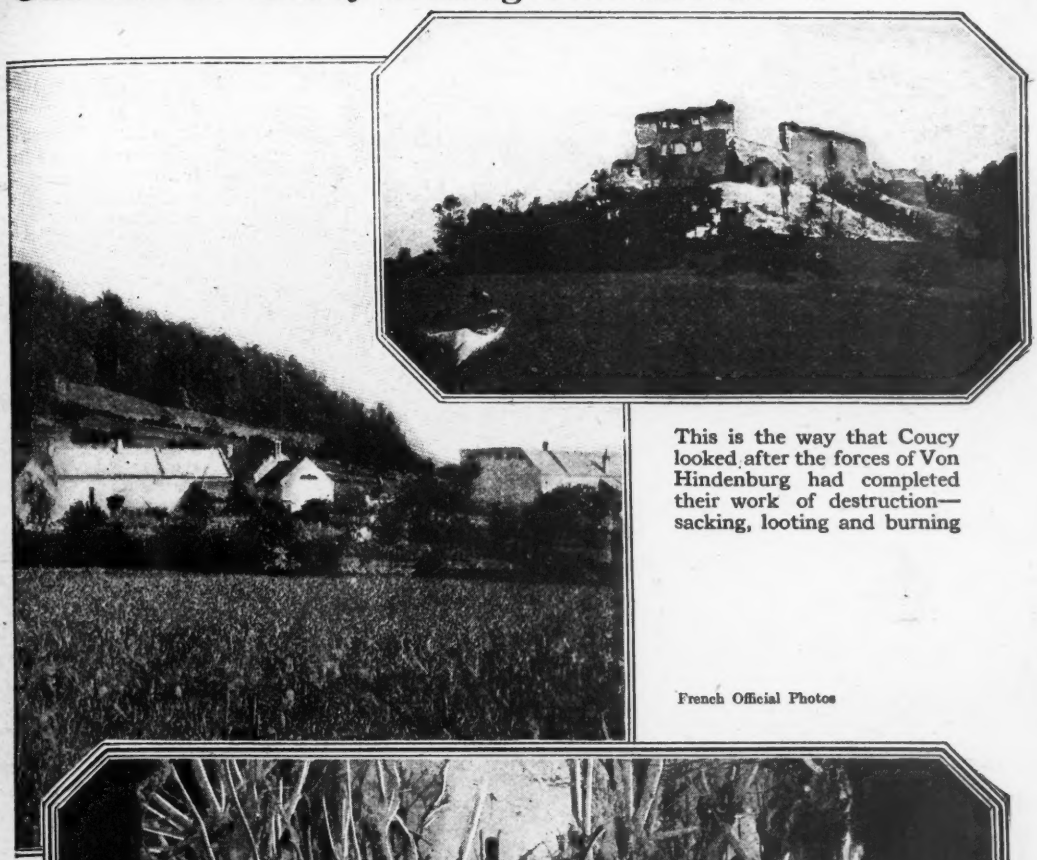


A glimpse of the chateau de Coucy, in the Aisne region, a few miles from Laon, France, before Von Hindenburg began his famous "strategic" retreat in 1917



In this view of a tree-covered walk taken from the castle there is no hint of the devastation to come, nor of the vengeance that the invader can wreak. But cast your eye, now, on the next page and see what dynamite and ruthlessness can do to ruin works of art

Chateau de Coucy During His Retreat



This is the way that Coucy looked after the forces of Von Hindenburg had completed their work of destruction—sacking, looting and burning

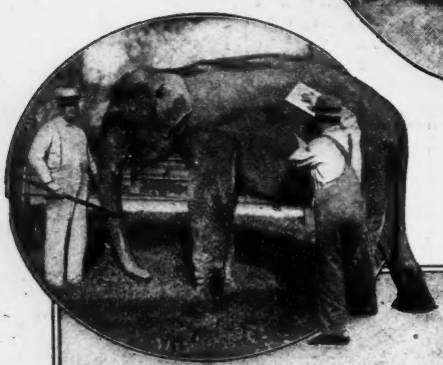
French Official Photos

How the same walk photographed from the same place, shown on the opposite page, appeared after the Germans had left Coucy. It took them only a few hours to effect this transformation. It is a fair sample of German frightfulness

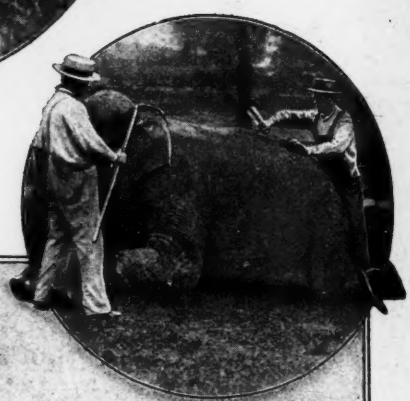
"The Elephant Hath Joints, but None for Courtesy;

Bathing an elephant isn't as simple as giving a pet dog his dip. First, the skin of the jungle animal has to be entirely sandpapered

In order to prevent the brute's skin from cracking several gallons of olive oil are applied

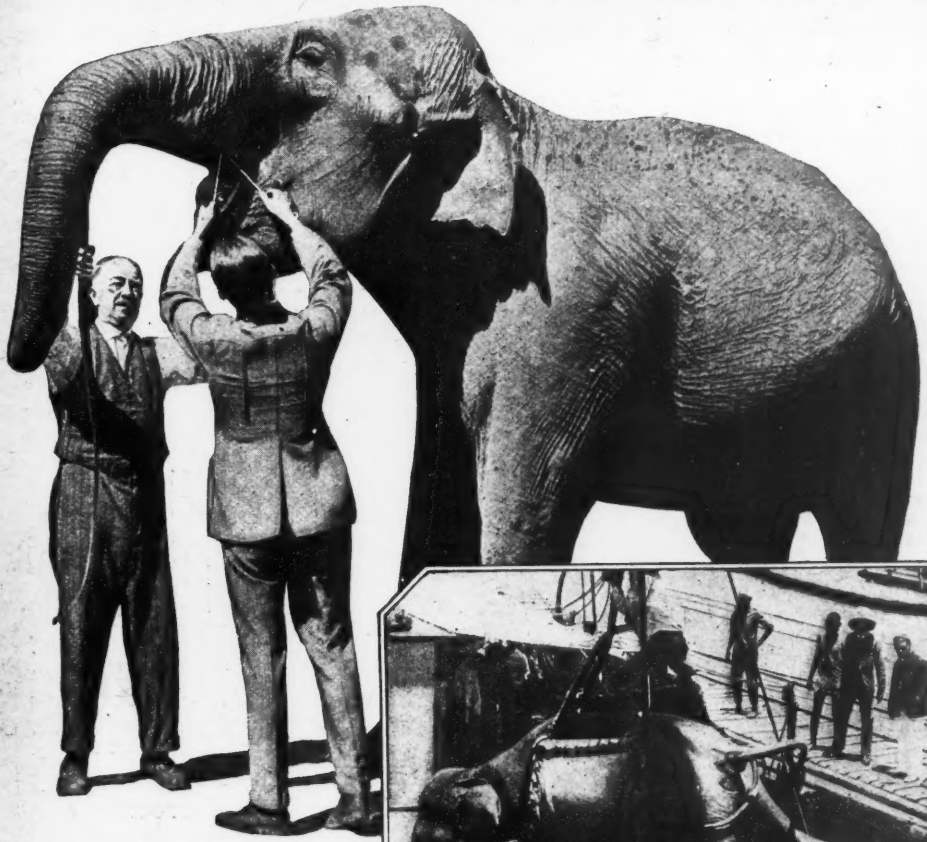


It is also necessary to go over the not inconsiderable expanse of hide with soap and water

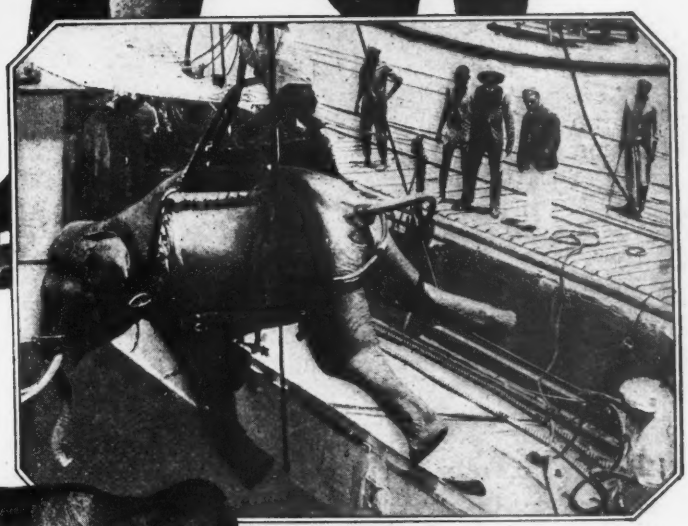


The elephant is not only taking the place of the horse on the farm in England, but is becoming a farmer too. This elephant has been taught to pitch hay

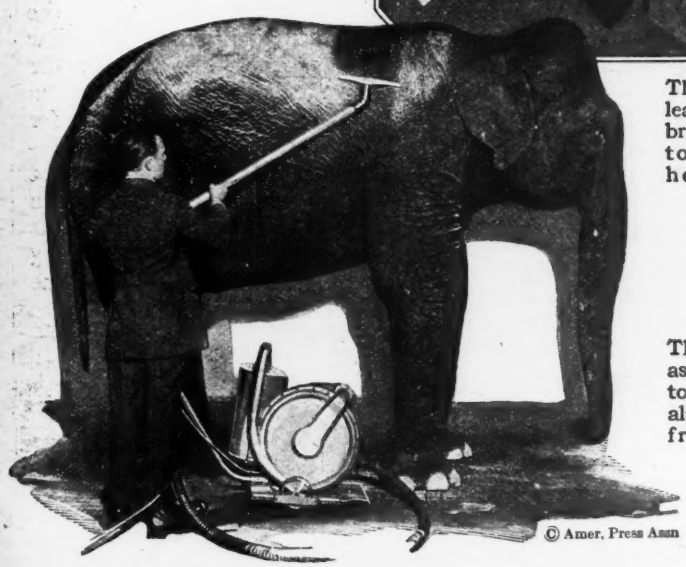
His Legs Are Legs for Necessity, Not for Flexure'



Maude, of the Atlanta, Ga., zoo, had a tooth pulled without even taking gas. But she cried when the operation was over



This elephant didn't want to leave its jungle home, so a breeches buoy was employed to lower it into a ship's hold at Rangoon, Burma



The vacuum cleaner, regarded as belonging almost exclusively to the household equipment, is also used to remove dust from the elephant's hide

© Amer. Press Assn

A Cage for Photographing Growing Wild Flowers

THE photographing of wild flowers after they are picked is at best only fairly successful. Wild flowers are inclined to wilt quickly. The finest results are obtained by time exposure; but probably no other class of subjects is so difficult to photograph. There is almost always some vagrant wind to prevent a good time exposure.

This portable cage will enable you to photograph flowers as they grow—without interference from winds

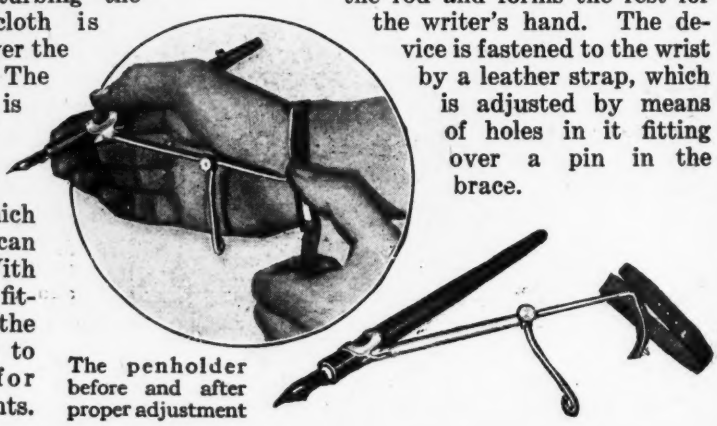
To obviate the trouble caused by wind, the "cage" shown in the accompanying illustration was devised and used by the State Botanist of New York. With it nearly four hundred successful photographs of wild flowers were obtained in less than one year.

The sides and top of the cage are made of a transparent cellulose compound. The back is made of light wood before which any tint of cardboard may be placed as a background for the flowers. The front consists of an open frame around which a piece of black oilcloth is tacked. This oilcloth has a small opening beneath so that adjustments of the camera lens may be made without disturbing the apparatus. The oilcloth is made to funnel down over the front of the camera. The bottom of the cage is made of tough cardboard (or light wood) and provided with an opening through which the stems of the plants can pass into the cage. With wooden extension legs fitted to the bottom of the frame it can be raised to any height needed for photographing tall plants. When used in this way a good-sized stone placed inside the cage will keep it from trembling, even in a strong wind. In bright sunlight a piece of white muslin pinned over the device will soften the strong shadows.

The back and front of the cage fold down over the bottom. The sides come off separately, and when folded upon the other parts, with the wooden extension legs make a package about 3 by 2 feet and 5 inches thick. This is easy to carry by means of a couple of small woven trunk straps and a handle.

How Children May Be Taught to Hold the Pen Correctly

A SIMPLE device has been patented by William J. Henry, of Akron, Ohio, to train children to write properly. The pen is held in a clamp which is hinged to the end of a short metal tube having a sliding extension which may be set by the tightening of a set screw to fit the device to any size of hand. The collar bearing the set screw also carries the brace which extends at right angle from the rod and forms the rest for the writer's hand. The device is fastened to the wrist by a leather strap, which is adjusted by means of holes in it fitting over a pin in the brace.



The penholder before and after proper adjustment

How the "Smileage" Shows Travel

Collapsible scenery and improved "properties" solve the problem of transportation cost

By A. M. Jungmann

THE war has taught us that "It can't be done" is a sentence which we may as well leave out of our language. This is exemplified in the manner in which the scenery for the Smileage plays is handled. Take "Turn to the Right." Before that became a Smilage Play, a baggage car sixty feet in length was required to accommodate the scenic equipment when the play was on the road. Persons who have seen this play will remember that the scenery included a farm and cottage, a peach orchard, a pawnbroker's shop, a kitchen, a well, and an automobile in action.

The peach tree in the successful Broadway production, "Turn to the Right"—blooming in Act II, laden with fruit in Act III

Now the scenery for the prologue and the three acts of the play has been so arranged that it can be packed into bags and trunks and hauled by army trucks. It is all collapsible. The scenery is made of canvas and the large color masses are made with aniline dye instead of being painted. This is done so that it can be folded without cracking. When the play begins each week's performance at the camps, the canvas must be stretched and tacked on wooden battens and erected into sets. No piece of scenery or batten is more than fourteen feet in length. Each batten and section is numbered so that there is no confusion when a scene is set up. When this play is packed and ready for transportation, the entire peach orchard is put into a portmanteau; the two-story house, twenty-six feet high, is packed snugly into the kitchen cupboard, and the kitchen, with the exception of the old-fashioned pump and crockery, is packed into army trunks. If, before the war, anyone had suggested the possibility of giving a play with collapsible scenery and having that same play up to the Broadway standard, there would have been a general chorus from theatrical producers, "It can't be done!"

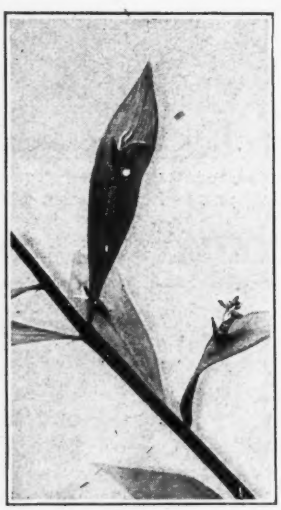
The time is coming soon when all traveling theatrical companies will pack their scenery as they pack their costumes—in bags and boxes, and their properties in trunks, crates and barrels to prevent breakage.

Goldfish are attracted by a flashlight to the surface and dipped up with net without any fuss, splash or splutter

The Flashlight Makes It Easy to Take Goldfish from Pools

TAKING goldfish from a large pool is not an easy problem—particularly if it is to be accomplished without frightening the fish literally to death. Mr. Dwight Warren, one of the residents of Alhambra, who has a Japanese garden, in which is a large pool full of goldfish, has devised a plan by which the fish may be caught so that they may be moved from pool to pool or from pool to globe without the slightest chance of injury.

Mr. Warren handles his fish at night. He uses a small hand net and a pocket flashlight. The fish are attracted to the surface by the light held against the surface of the pool. The instant the light is cast in the water, the fish swim up and nose around the light. The net is then placed under them, and they are lifted out of the water without the slightest trouble, fuss, splutter or splash and transferred to another pool or put into a globe. The fact that fish are attracted by a light at night is too well known to require reiteration. In any case, the experiment is worthy of a trial.



The leaflike organs bearing the flower are not leaves but twigs

Plants with Flowers on Their Leaves

THE hot midsummer's heat in the light, dry woods of southern Europe, where the interesting varieties of butcher's broom (Ruscus) are found, lulls everything into a deep and peaceful sleep and while the other plants look dead the "Ruscus" alone remains green. The shoots of these plants are not round or stalklike, but are, in part, thin elongated surfaces resembling leaves, which are attached to the main stem by rounded stalks similar to the petioles of leaves. Strange as it may seem, these growths are shoots or branches and not leaves. Only in the first stage of the development of the plant, true leaves are found, and these resemble small, pale scales which are attached to the long rounded shoots. Between the scales the leaflike shoots, which the botanist calls phyllodes, soon begin to grow. The scalelike leaves wither and fall after the shoots have developed. The phyllodes then assume the functions of the missing leaves, which they so closely resemble in outward appearance. Otherwise they have the characteristics of ordinary rounded twigs or shoots. Upon the surface of these flattened shoots, scalelike leaflets again make their appearance. Small flowers with short stems thrust themselves between the scales and these, after fertilization, bear seeds, by which the Ruscus may be reproduced.

These peculiar plants are not too common. They are fascinating when they are decked out with small dainty flowers and are of exceeding interest to the botanist and the naturalist. Children over there enjoy gathering them as children in this country enjoy picking the lovely arbutus.—DR. E. BADE.

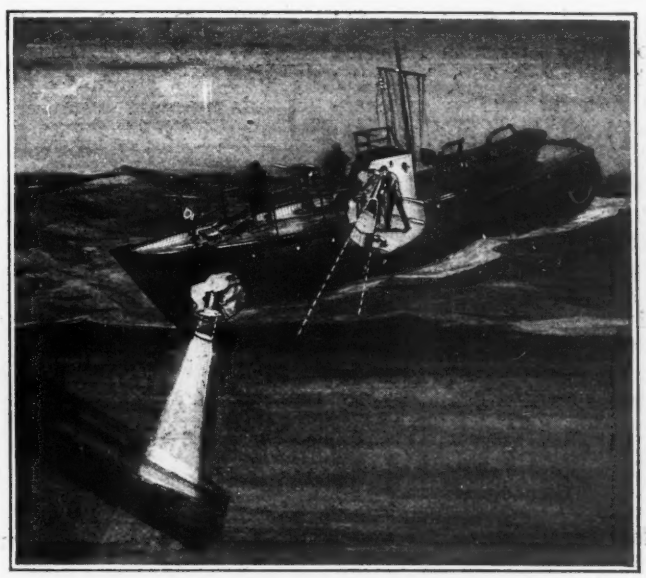
Ornamental Identification Rings for Soldiers and Sailors

A NOVEL finger ring, made of silver or gold, as desired, has been devised as a parting gift for that boy who is going across the sea to fight Uncle Sam's battles. On one side of the ring is a soldier or sailor in relief work, on the other side an eagle. Raised emblems of the fighting man's initials, regiment, and company ornament the top of the signet. Our illustration gives a fair idea of the appropriateness of the designs of these rings. The ring will serve a double purpose, as a keepsake, and a means of identification.

A symbol of friendship and faith for the parting boy in khaki or blue

Finding U-Boats in the Depths of the Sea

"MAN the observing tube and watch sharply," is the command given by the captain of the submarine chaser. In the gloomy light his binocular has shown him a distant periscope and it behooves him to be cautious. Just behind a gun on the forward deck of the submarine chaser an observer takes a position at one end of a viewing tube which intersects the bottom of the vessel and enables him to sight objects under the surface of the water. He is aided by a viewing plate in the tube and a powerful electric searchlight behind lenses in the bottom of the vessel near the bow. The rays of light illuminate the depths of the ocean and reveal even small objects clearly. Valves are arranged to prevent water from entering the vessel and also to keep it in the tube close to the viewing plate in order to accentuate the visibility of objects through the tube.



Showing the under-water telescope in action provided the searchlight could be made to penetrate the depths

The observer scans the depths for a time without result. At length, however, he glimpses a submarine many feet below. The submarine is moving slowly and the "chaser" adapts her speed to that of the U-boat. Quickly the chaser's commander gives orders for the release of a depth bomb. Through the tube the observer sees the death-machine drop on its mark. There follows a great disturbance of the waters where the submarine has been. Afterward the lenses reveal only dismembered parts of the submarine.

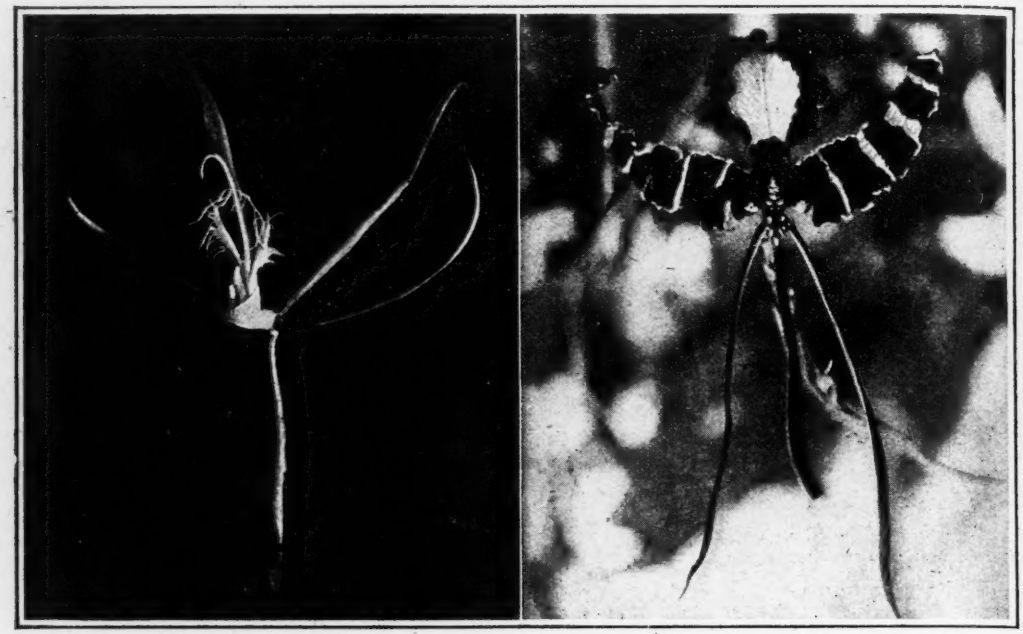
It is thus that Alexander Egenes of Lower Rochester, Nevada, would combat the submarine menace; for he has invented a submarine chaser which embodies the features unfolded in the foregoing description. But Egenes forgets many things. In the first place, electric lights have no great penetrating power in water. In the second place, the waters of the North Sea and the North Atlantic Ocean are usually so rough that even if the most powerful searchlights could be directed downward, nothing but murkiness could be seen.

Camouflage in the Wars of Nature

THE two flowers shown in the accompanying illustrations are remarkable instances of natural mimicry, one strikingly resembling a butterfly, the other a spider. Both belong to the orchid family and grow wild in South America and the West Indies. The butterfly orchid is occasionally grown in hothouses in the United States and attracts attention by the beauty of its coloring and the close resemblance of the open flower to a butterfly with striped upper and bordered under wings. Even the long proboscis and the antennae of a butterfly are mimicked. The mimicry of the spider orchid is not so exact, but sufficiently so to justify the name given to its dainty and strange form.

This mimicry is not a freak of Nature. Scientists believe that its object is to protect the species by attracting beneficial influences or by repelling those that militate against its preservation.

The orchid family is highly developed. It comprises more than twelve thousand species, most of which grow wild in the tropical jungles of India and Brazil. Few species are found in the temperate zone. Many of the orchids, especially those growing in the tropics, are noted for their peculiar structure and exquisite beauty of form and coloring. They grow on other plants, but derive their nourishment principally from the air.



The peculiar-shaped orchid shown on the left is named "Spider," which it distantly resembles. The other is called the "Butterfly" orchid and looks exactly like a butterfly

Why Does Paper Turn Yellow With Age?

IT is a well-known fact that paper exposed to light will become yellowish within a comparatively short time; and even when kept in storage where light does not reach it, it will undergo gradual deterioration. Recent investigations by Dr. Klemm have demonstrated that these changes are due mainly to the presence in the paper of mechanical wood-pulp or lignified fiber, although they are met with also in paper colored with dyes that fade under exposure to light. In wood-free papers the fading is found to be due to a formation of soaplike compounds of iron with rosin and fatty substances. The greater the amount of these compounds present, the more marked the yellowing of the paper. A mixture of ether (two parts) and alcohol (one part) will remove the soap-like matter.

Fountain Comb for the Treatment of the Hair

IN the treatment of hair it is often desirable to reach the parts nearest to the scalp and the scalp itself without coming in contact with the other parts of the hair. The rubbing of ointments and salves into the scalp has always been troublesome and often ineffective because most of the ointment never reached the scalp, but was smeared upon the hair. The well-known fountain comb, recently improved by E. McG. Jones, of Winchester, Ky., is intended to remedy the defects of the old method. It consists of a reservoir for holding the liquid or salve to be applied to the scalp or to the roots of the hair and a device for forcing the contents of the reservoir through the teeth of the comb.

The irrigating comb and method of using it on the scalp

The pressure is supplied by compressed air which is conducted to the reservoir by a flexible tube. The reservoir does not connect directly with the teeth. To reach the teeth the liquid in the reservoir must pass through an opening into a tube from which channels lead to the teeth. The opening to that tube is controlled by a valve operated by a push button from the top of the contrivance.

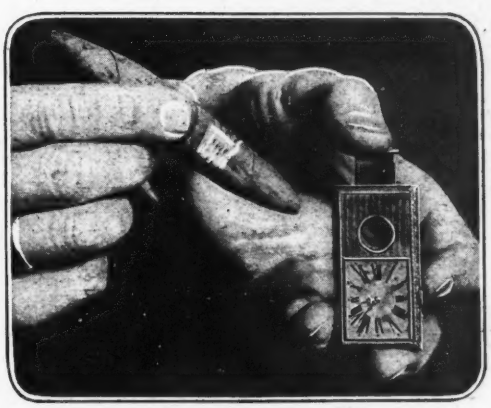
The illustration on the top shows clearly how this fountain comb is operated. The operator holds it in his right hand and presses the button when he wants the salve or ointment to go into the tube from which it flows down the teeth of the comb.

The Cost of Enrolling a Soldier in Uncle Sam's Army

FIGURES compiled from the records of the first draft show that it cost the Government almost exactly five dollars for each man drafted. All but seven cents of this amount represents the expense of the draft boards. In comparison with this, it is interesting to learn that the volunteer system of recruiting cost $24.48 per man in 1914; $19.14 in 1915; and $28.95 between July, 1916, and April, 1917. These latter figures, however, included the recruit's traveling expenses and the cost of his subsistence prior to acceptance.

Time for a Smoke? Take Out Your Combined Watch and Cigar Cutter

COMBINATION tools and combination appliances have been invented in large numbers and with varying degrees of regard for the fitness of the combinations. Here is a new combination, recently invented and rather original. It is difficult to decide whether it is a watch combined with a cigar-cutter or a cigar-cutter combined with a timepiece. The inventor has undoubtedly conferred a great boon upon the class of methodical smokers who regulate their "smokes" in accordance with the time. By looking upon the watch they can tell at a glance that it is time for another cigar—no matter whether the watch goes or not. The cutter is always ready.

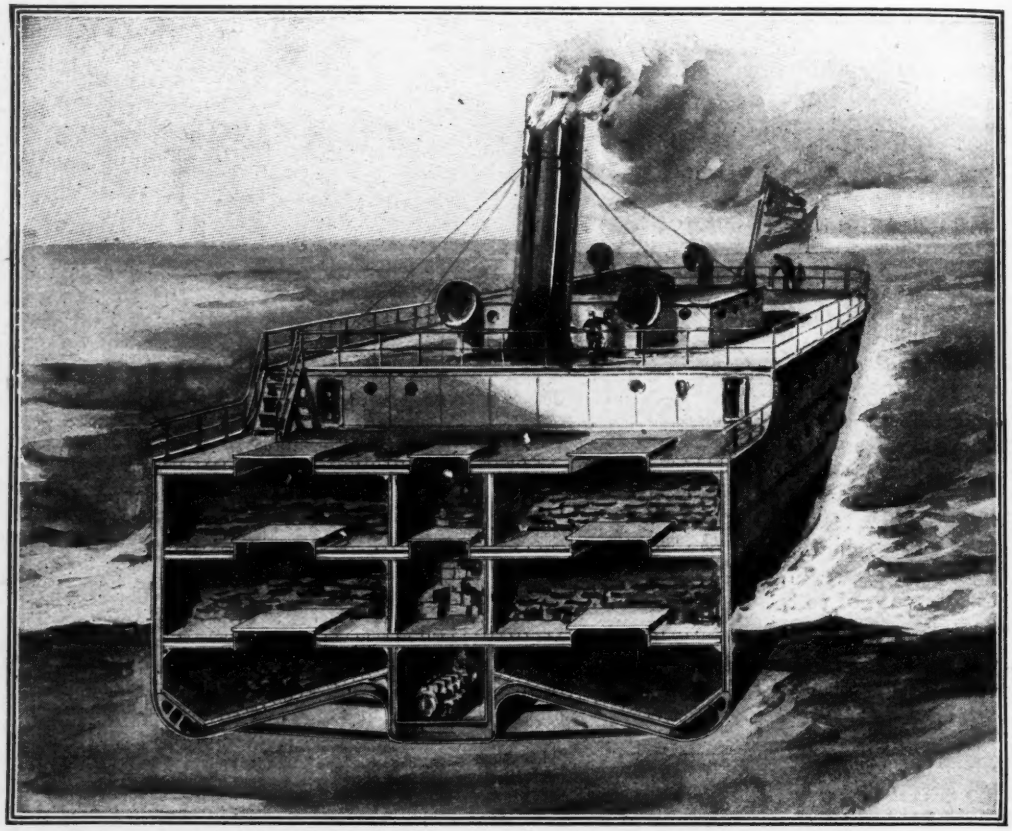


The time-keeping cigar-cutter and how it works by thumb pressure

Let the Torpedo Go Under the Ship

Shallow-draft ships to foil the submarine

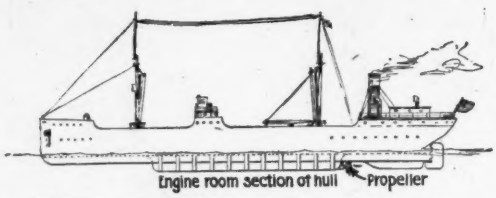
By Joseph Brinker



This cross-section through one of the proposed shallow-draft torpedo-proof ships shows the concave bottom and the tub-like compartment in which the engines are installed

TORPEDOES are set to travel a depth of ten to fifteen feet. Hence it has been suggested that the submarine problem can be solved by constructing 3000-ton ships which draw only five feet of water, except in a limited portion of the hull which has a draft of eight feet.

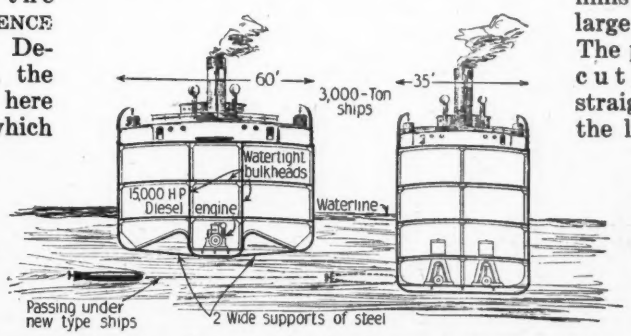
The shallow draft has been made possible by increasing the beam or width of such a vessel to about sixty feet as compared with thirty-five feet on ordinary ships of the same tonnage. The new type of ship has a concave or hollow bottom. When going at full speed the ship will have a tendency to "plane" or glide over the surface of the water, somewhat like a fast racing motor-boat. Because of its great beam, the distribution of the cargo space is greatly simplified. Oil engines are to be placed in a tub-like compartment which extends three feet below the bottom line. This gives a total loaded draft of eight feet, which is about one-half



Diagrammatic side view of one of the torpedo-proof steamships. Note the engine-room section and the propeller behind

that of the ordinary ship. It is this large reduction in the draft that is supposed to make the ship torpedo-proof.

While the location of the engines in a tub-like appendage is not new (it was illustrated in a small thirty-foot boat described in the POPULAR SCIENCE MONTHLY of December, 1917), the design shown here is the first in which the principle has been applied to large cargo-carrying ships for ocean travel. The hull enclosing the engines is braced to the sides of the concave hull proper by means of two-foot plates of steel, placed about ten to fifteen feet apart. These plates will tend to assist in the gliding or "planing" of the ship when it is going at high speed.

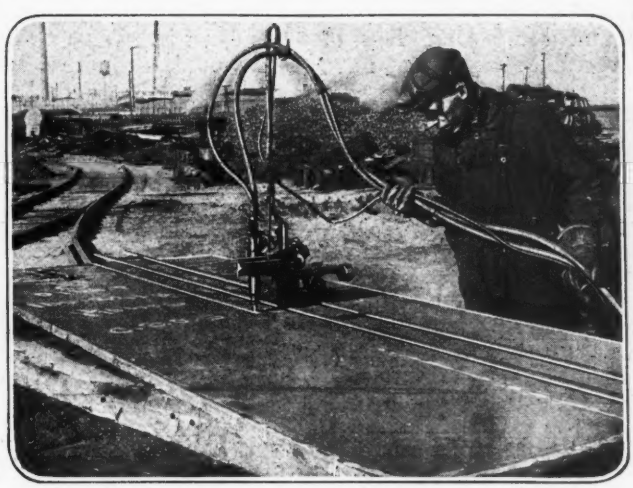


The torpedo will pass under the shallow draft-ship, but will strike the ship of conventional type and deep draft

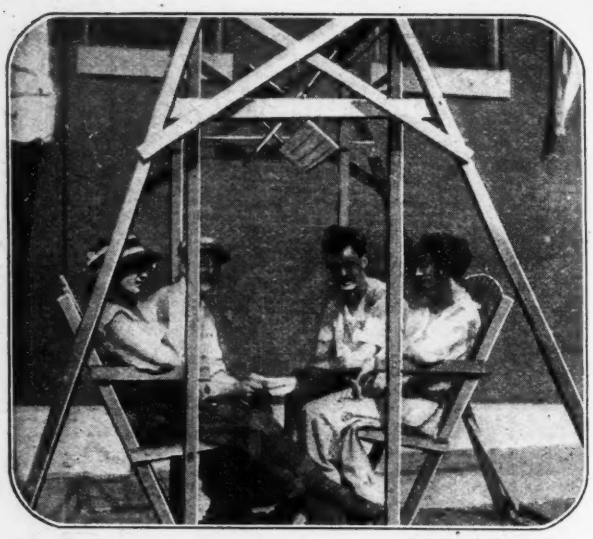
The engine compartment is separated from the rest of the hull by water-tight bulkheads. The inventor claims that, even if the engine compartment should be struck and destroyed by a torpedo, the water would not rush into the hold of the ship. He thinks that the 1500 horse-power oil engines would be capable of giving to the ship a speed of thirty-two to thirty-eight miles an hour, but this estimate is undoubtedly too high. Such a speed would enable the ship to run away from any submarine built up to the present time. But even if the ship's speed should be less its shallow draft would enable it to dodge a submarine's torpedoes.

An Oxy-Acetylene Cutter That Runs On a Railroad Track

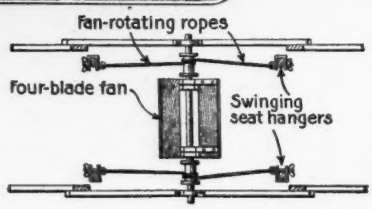
THE illustration shows an interesting application of an oxy-acetylene cutter, which is used at one of the great mills for cutting large steel plates. The plates must be cut perfectly straight. To follow the line by hand is tedious and unsatisfactory because it is invariably more or less inaccurate. Accordingly, the idea was conceived of mounting the blowpipe nozzle on a wheeled stand, and using an electric motor to move it backwards and forwards along a miniature railroad track, which is laid on the metal slab to be cut. The line along which the slab is to be cut is first chalked out, and then the track, which is all in one piece, is laid down parallel to it with a gage. The machine is placed on the track, and the operator controls both motor and gas pressure by suitable mechanism. He starts up the motor and the machine runs slowly along the rails, cutting the slab precisely along the line. The time saved by this new method is considerable, and the precision attained is much greater than by the hand method. Moreover, this machine is easily operated by one man, who need not be a skilled mechanic. In fact, any man with common sense can run it successfully.



With this device and the miniature track heavy steel plate can be cut with rapidity and absolute accuracy



A lawn swing equipped with cooling, revolving fan



To the left—mechanism that makes the fan rotate

Compelling the Lawn Swing to Work a Fan

IS it impossible for you to "get a breath of air? Is the house stuffy? Are even the moving-picture theaters languid from the humid heat? Can you not find a refuge from the sweltering heat even in the cellar?

Well, try this and be cool. If you have a lawn swing and ten square feet of ground on which to place it, you may have a breeze, no matter if you are sandwiched in between six-story apartments.

Here's the way. A Missouri inventor recently has perfected an automatic fan for lawn swings, which the "back and forth" motion actuates and controls. As you and your girl sit facing each other, you have only to push gently on the footboard. The swing moves slowly to and fro, causing the fan overhead to revolve steadily, sending down a pleasant cooling breeze.

The fan, a four-blader, can be bought cheaply. It is constructed to fit any lawn swing. A man can adjust it in five minutes.

The inventor of this device may be assured the gratitude of suffering humanity. Unless courting becomes a thing of the past, youths and maidens this coming summer will rise up and call him blessed; unless they prefer to do so sitting down, as they swing back and forth in comfort.

A Boat Landing That Is Adjustable

A BOAT landing which can be adjusted to various water levels has been invented by William C. Ross, of Columbia, Ohio. In principle it does not differ materially from the Morris chair. The landing consists of a platform, a prop, and a supporting member which takes the place of the usual wooden piles. Both the platform and the supporting member have holes so that they can be raised or lowered to meet the different tidal conditions. However, it is necessary only to remove the pin which holds the landing to the supporting member in order to adjust it. With a heavy landing, this would necessitate considerable work. Should it be desired to adjust the landing several feet at a time, it might become necessary to remove the pin from the prop as well. The ordinary floating landing now in use would seem to offer advantages over the one described here.

But doubtless the inventor is able to demonstrate wherein this product of his inventive genius is superior.

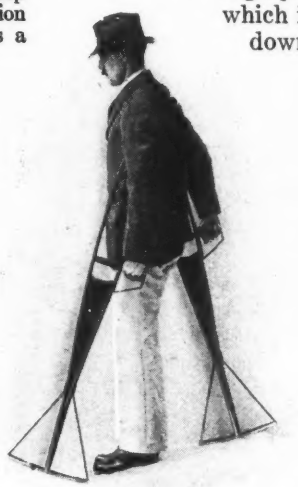
The landing can be raised or lowered by removing either one or two pins

The Rocking-chair Crutch and Why Cripples Should Use It

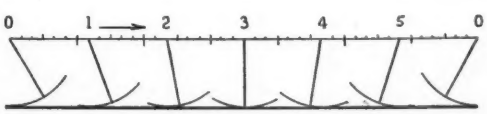
DR. ROBERT G. HALL, of Portland, Ore., has devised a new type of crutch based upon sound mechanical principles and extremely simple in construction. In his preliminary report to the American Medical Association, Dr. Hall points out:

"The present form of crutch, with only slight modifications, has been used since antiquity. At least no change on the mechanical principles involved has been made. When a step is taken, the tip is at a fixed position on the ground, and the crutch, as a radius, revolves about it. As a result the shoulder follows the form of an arc, first rising and then falling with each step. Thus, for a man using a 55-inch crutch, if his weight is 180 pounds and he takes a 2½ foot step, he will rise and fall two inches, which means that 30 foot pounds of energy are wasted at each crutch step."

In devising his rolling crutch, Dr. Hall reproduced in metal the shoulder curve of the crutch and applied this metal arc in the form of a rocker to the base of the crutch. When such a crutch is used the shoulder end travels in a straight line. The jerky, up-and-down hobble so characteristic of the old crutch is changed by this device into smooth, wheel-like forward motion. The diagram shows the successive stages of this wheel-like progress clearly.



In descending hills, the downward rolling motion is retarded by the rear handle-extension



This diagram shows seven consecutive phases in the rolling crutch's motion

The originator of this device admits that the rolling crutches are cumbersome and apt to get in the way of other people, that they are heavier, more expensive and more complicated than the old crutches; but that they also have many advantages of fundamental importance. They mean a saving of strength and energy; they lengthen the step without additional effort, give better support and steadiness to the body and lessen the jar to the human system considerably.

Dr. Hall has devised rolling crutches with rockers 14½ inches long and folding crutches with rockers 31 inches long which, when folded, are only 12 inches long. The crutch with 14½ inch rockers is probably the most practical, as it is less cumbersome and awkward to handle than the one with longer rockers. The addition of an extension to the handle of the crutch is of advantage. By its use in front or in the rear of the crutch the rolling motion may be changed to a rolling-up or a rolling-down motion which is helpful in walking uphill or downhill.

Studying History at First-Hand

LIGHT travels at the rate of 186,000 miles per second. As everyone knows, we are now looking at some stars with lights that left them centuries ago.

Suppose that you could be shot into space at a velocity greater than that of light. And suppose that you were armed with a telescope so powerful that you could see everything that happened on this earth. A time would come when history would unfold itself before your astonished eyes. You would see Napoleon losing the Battle of Waterloo; you would see Benjamin Franklin and all the other signers of the Declaration of Independence vowing that they would be hanged rather than endure British oppression any longer; you would see the surrender at Yorktown, the Battle of New Orleans, and the naval fight off Santiago; you would see the death of Julius Caesar, and then Mark Antony making love to Cleopatra on the Nile. If you like, you could juggle yourself back and forth so that you could see the same event over and over again and make a special study of it.

A specimen of the ugly, poisonous spider (Cactus Tarantula) that infests cactus jungles in Texas

Beware of This Horror of the Cactus Jungle

THERE are many pleasanter places than the cactus jungles which are found in different parts of southern Texas. Luther Burbank has produced a spineless cactus, but that isn't the kind that grows in these jungles. Besides the large assortment of perfectly good and efficient "stickers" of which the Texas cactus jungles can boast, an incredible large variety of living creatures, apparently created for the special purpose of making these jungles more interesting to unsuspecting travelers, may be found in these localities.

One of these denizens of the jungle is shown in the picture—a very difficult photograph to make, for which we are indebted to Dr. H. Menger of San Antonio, Texas. It is a large variety of the Cactus Tarantula, a vicious and poisonous jumping spider, which, in the illustration, is seen lurking at the upper entrance to its silky white breeding nest. This nest, woven by the big spider, extends to the left of the picture and covers part of the cactus leaf. The spider usually builds its nest between two cactus leaves close together, to be protected against the cactus wren and other insectivorous birds.

These spiders are powerful, fierce, and excellent jumpers. Their food consists of insects. All of them are more or less poisonous.

How to Avoid the Spontaneous Combustion of Coal

UNLESS coal piles are well ventilated spontaneous combustion will follow. To prevent spontaneous combustion, the Bureau of Mines gives these suggestions: (1) Build a coal pile on dry ground. (2) Store only one size of coal in each pile. (3) Remove fine coal for immediate use if possible. (4) Don't wet and dry the coal alternately while piling. (5) Store the coal in small piles near the place where it is to be used. (6) Use small bins in storage yards.

If You're Weak in Arithmetic Let This Device Do the Work

A DEVICE designed for accurately reckoning the number of small articles has a quantity scoop on top of the apparatus and a ratio scoop at the end of a scale. In order to make the scale balance, each unit placed in the ratio scoop calls for fifty times as many in the quantity scoop. There is so little variation in the weight of small articles, however, that, to insure accuracy, more than a single unit should be placed in the ratio scoop.

This scale can also be used to compute the postage for parcels and the rates according to zones, being graduated to read in eighths of an ounce.

A scale to count articles and determine postage for parcels according to zones

Making the Soldiers' Undergarments Proof Against Vermin

THE chemistry department of the State University of Iowa is taking the initiative in making undercloth-ing vermin-proof for use by American soldiers in France. Undergarments made by Red Cross groups, or relatives and friends of the soldiers, are sent to Iowa City, where they are treated to withstand "trench lice." The clothes are put into a laundry washer which contains a mixture composed of sulphur and naphthalene dissolved in gasoline. Twelve thousand pieces have already been treated, students of the chemistry department doing the chemical work and the women of the domestic science school attending to the packing and shipping of the garments.

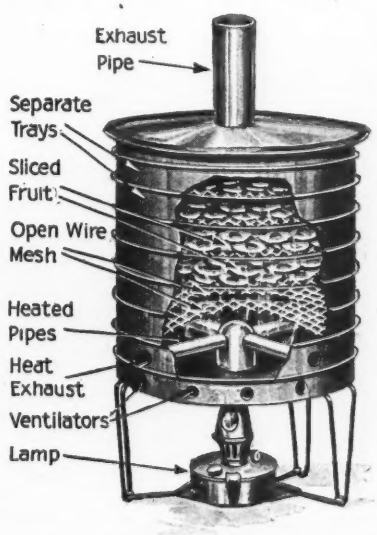
Treating clothes so that they will be vermin-proof—an American chemical discovery

Sanitary, vermin-proof clothing insures comfort as well as health, as "trench lice" are known to be carriers of disease germs, especially of typhus.

A Kerosene Lamp for Fruit Drying

THE lack of suitable apparatus for evaporating fruit and vegetables for preservation has been felt keenly in many rural communities where neither gas nor electricity is available. A simple and thoroughly sanitary evaporator for fruit and vegetables, in which a kerosene lamp supplies the required heat, has recently been placed in the market and should prove practical for farmers and housekeepers in small villages.

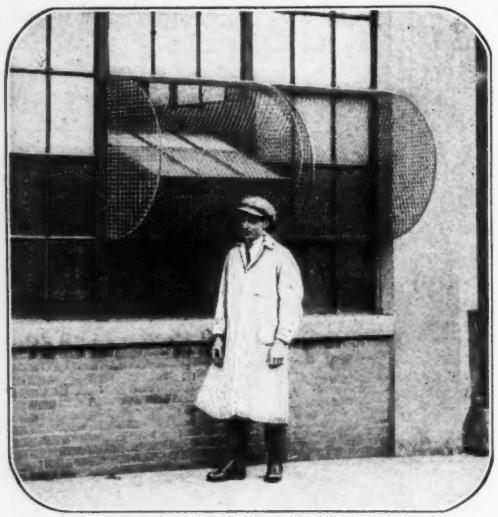
The device consists of a stack of seamless pans with wire-net bottoms and a heater underneath them. The pans have a diameter of eighteen inches, and six of them are provided, affording a drying surface of nearly ten square feet. This gives a capacity of three to four bushels of apples per day and a proportionate capacity for drying other fruits or vegetables. The heater is so made that the direct draft from the lamp goes through the heater only and does not enter the evaporating trays. The fruit cannot absorb the odor of the burning oil of the lamp.



This evaporator is operated by an ordinary kerosene lamp

Making Cannon Powder Explode Gradually in the Barrel

A propellant explosive, such as is used to propel a shell from a cannon, has its rate of explosion controlled to a certain extent by varying the chemical composition and the size and shape of the grains of powder composing the charge, so as to be consumed gradually. It is essential that the explosion of the powder occupy the same space of time that it takes the shell to pass through the bore of the gun, in order to utilize in full the propelling force of the charge. In a small-bore gun this occupies about one-fifth of a second. This is true of the 3-inch gun.



Wire screens placed around the open window sash prevent injury to the passer-by

Passers-by Are Protected from this Open Factory Window

A MAN passing close to a factory wall, where one of those outward slanting windows happens to be open, might sustain a serious injury by knocking his head against it. An automobile plant in Detroit has recently attached wire guards to its lower windows, so that, when they are open, adequate protection will be afforded against just such accidents. Our illustration shows how these guards are adjusted.

Aviators, Electrically-Clad, Defy the Cold

B-R-R-R! It was cold—so cold that the watch of a sentry in the Allies' camp had stopped. He pointed commiseratingly at the aviator who was soaring aloft in the driving snow storm.

"That fellow's going to suffer more than we are," he remarked to a companion, "going way up among the clouds."

The sentry's sympathy did not seem out of place in view of the fact that at high altitudes (8,000 to 20,000 feet) the temperatures are freezing, even in midsummer, and that some aviators who fight at 20,000 feet are as cold as the men who reach the North Pole. But, as a matter of fact, the airman was probably much more comfortable than the soldiers on the ground below him. For he was snugly clothed in an electrically-heated garment. Electrically-heated shoes kept his feet warm, and he wore an electrically-heated hood and gloves.

The garment was provided with three circuits or coils wrapped in the fabric of the cloth. They encircled his body. These circuits, which were parallel with one another, were distributed so that all parts of the garment were heated when they were connected up, a corresponding warmth being produced in the shoes, hood and gloves. The windings extended through a switch mounted on a thermostat made to expand under heat. In the insoles for his shoes as well as in the gloves and hood were wires connected with the windings of the garment. Current from a storage battery was supplied by adjusting a contact screw.

After a time the temperature of the garment rose to such a point that the thermostat began to expand. This operated the switch and as a result the contact point of one of the coils in the garment was drawn away from a contact point connected with the main circuit, cutting off the current. Further expansion of the thermostat cut off the circuit of another coil in the same way, and as the temperature continued to increase the heating power of the third winding was taken away. Then the temperature of the garment began to lower again, permitting the circuits to be reconnected. Thus the temperature of the cold dispeller was automatically regulated. The thermostat mechanism was enclosed in a casing and placed where the temperature of the garment caused it to operate.

Clothed in this suit, the aviator has no fear of extreme cold

So, you see, the sentry's sympathy was wasted. As a matter of fact, every aviator is clad to resist cold.

The Armored Flying "Tank"

When Lufberry was killed battling with a German armored flying machine a new epoch in aviation dawned

By Waldemar Kaempffert and Carl Dienstbach

Our grandchildren will thrill to the story of Raoul Lufberry's bravery. He will go down in history as the man who died in fighting the first armored flying machine

From the painting by Lieut. Farré

OVER the American sector, north of Toul, a German biplane appears —a giant with three cars. In the central car sit a pilot and two observers; in the side cars are the powerful engines. Such huge, cumbersome machines are usually employed for bombing—rarely for combat. What an easy mark! Immediately two Americans start up, followed by two others. At twelve thousand feet they recognize the German for what he is—a huge Friedrichshafen or Gotha. They rush for him and pour in bullets. Nothing happens. The bullets rattle off. The German proceeds stolidly on his way.

Then Lufberry, the American "ace," leaps into the air. In his fast *avion de chasse* he overtops the German. He plunges down and fires as he dives. Again and again he turns, climbs and rains in bullets. The machine guns manned by the two fighters in the German machine vomit flame and lead. Suddenly Lufberry is seen to lurch. Smoke shoots up from his machine. He plunges. There can be but one terrible end—death by fire or death by a sickening fall. Lufberry unbelts himself, rises, and leaps from his machine. A bruised, almost unrecognizable mass is picked up in a flower garden. Thus the most famous American "ace" meets a Homeric end fighting the first steel-clad battle-airplane.

Why the Gothas Were Built

Now the idea of armoring an airplane is not new. European powers had decided that the weight required was prohibitive. Why then did the Germans succeed in solving the problem? Because the Zeppelins failed. Zeppelins had been successfully set on fire over London. A substitute had to be found if bombing was to be continued. And so the Germans invented the Gotha biplanes—mammoth machines driven by engines of unprecedented power, provided with fuel tanks of enormous capacity for long journeys, freighted with bombs weighing hundreds of pounds. Their arc of fire was not impeded in any direction. They could even shoot at a lower enemy through a tunnel. The British considered them almost equal in speed to all but the most recent small pursuit planes. True, they were unwieldy; they could not perform the gyrations of the smaller machines, but they could fight off faster machines armed only with fixed machine-guns firing through the propeller.

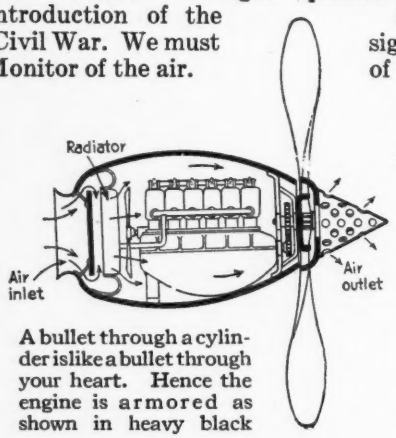
The Gothas and the similar Friedrichshafens and A.E.G.'s are intended to carry much fuel for long raids and a great weight of bombs. Suppose the bombs were abandoned altogether? Suppose that the radius of action, too, were reduced to that of a light, single-seated fighter, so that only a little fuel—enough for a two hour flight—need be carried? And then suppose that the weight represented by bombs and excess fuel were distributed in armor where it can do the most good? That seems to be the underlying idea of the new German battleplane. Fully twelve hundred pounds of armor can be hung on the machine's vitals if the principle is carried out. The essential point is that in order to be immune to the small fighting plane's bullets the giant Gotha requires but little more armor for adequate protection than a moderately sized machine.

The Merrimac of the Air

It is said that after Lufberry's death the German steel-clad flying tank was brought down. Whether it was or not, its appearance marks a new epoch in the

development of the military airplane, comparable with the revolution brought about by the introduction of the Merrimac in the Civil War. We must cast about for a Monitor of the air.

Size is in itself a kind of protection; for the larger the machine, the less are its beams, ribs and struts likely to suffer from bullets. Only a small part of the craft need be encased in steel. Since at least every tenth bullet is explosive and many more are burning torches, all wooden and woven parts must be chemically fire-proofed.

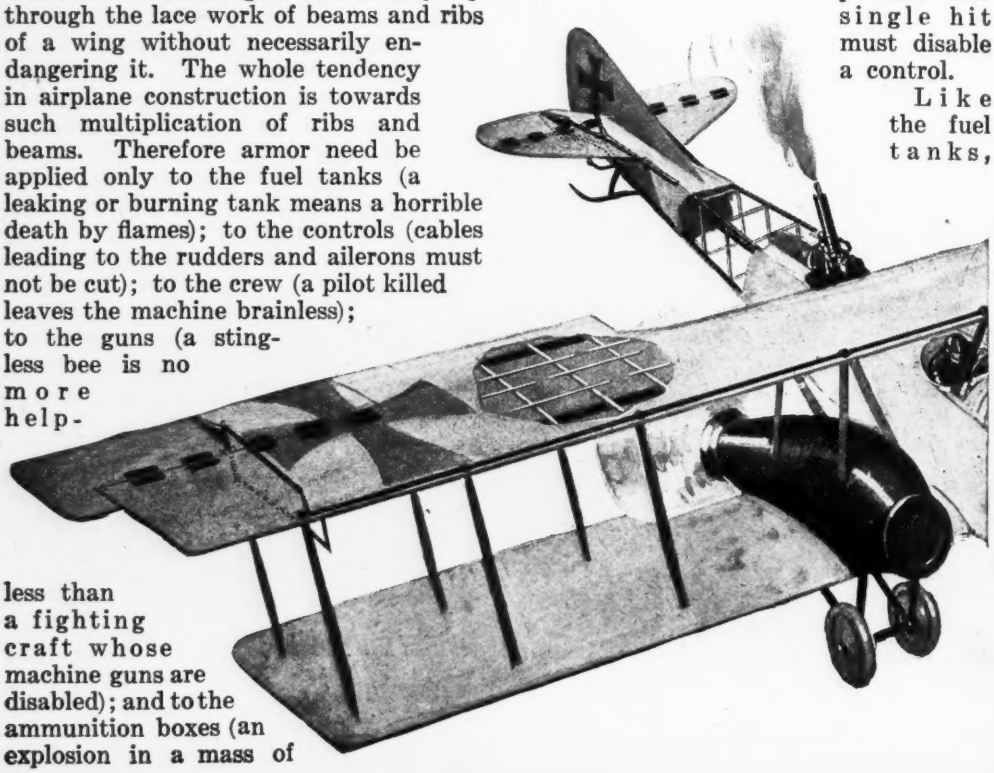


A bullet through a cylinder is like a bullet through your heart. Hence the engine is armored as shown in heavy black

The latticed masts of American battleships are so constructed that shots can pass through them without necessarily bringing them down. A similar principle may be adopted in building wing frames. Even now machine-gun bullets may rip through the lace work of beams and ribs of a wing without necessarily endangering it. The whole tendency in airplane construction is towards such multiplication of ribs and beams. Therefore armor need be applied only to the fuel tanks (a leaking or burning tank means a horrible death by flames); to the controls (cables leading to the rudders and ailerons must not be cut); to the crew (a pilot killed leaves the machine brainless); to the guns (a stingless bee is no more helpless than a fighting craft whose machine guns are disabled); and to the ammunition boxes (an explosion in a mass of cartridges is the equivalent of an explosion in a powder magazine).

How are the fuel tanks to be designed? The least possible amount of material must be utilized and yet the maximum volume obtained by a shape approaching a sphere's. The larger the tanks the better; for there is no proportionate increase of weight with increase of volume. An empty 500-gallon tank does not weigh a hundred times more than a 5-gallon tank. Let the steel be thick enough, and it becomes bullet-proof without other armoring.

The piping through which oil and gasoline is conducted must obviously pass through tubes of great thickness; control cables must be encased in armored tubes. Before the control wires emerge they are attached to bullet-proof chains. The exposed part of them must be shortened. The braces to which they are fastened must also be armored and joined to the rudder framing at many points. No single hit must disable a control.



Like the fuel tanks,

the engines may be greatly increased in volume and therefore in power without proportionately increasing their weight. Power depends on cubic capacity of cylinders. Hence a big engine may be armored, and yet its weight will be proportionately no greater than that of a smaller one. If the casing is to be bullet proof its weight need not be increased by more than three times.

Since we cannot have a battleship turret every man of the crew must wear a full suit of mail

Mail-Clad Knights of the Machine Gun

What of the crew? The pilot's is the guiding brain. The gunners are the fighters. Why not follow battleship practice? Armor the cockpits—that is the first thought that leaps to the mind. But must we copy battleships? How different are the conditions in the sky! The single-seated one-hundred-and-fifty-mile-an-hour fighter darts hither and thither like a wasp at such close range that his antagonist lives in the constant fear of seeing him vanish only to bob up in some new unexpected quarter. If the cockpits are to be armored protection must be provided on all sides. Do that and you convert them into completely enclosed turrets. But how can a man in a turret, peering out of sighting slots, keep his eye on an elusive wasp? And how can guns be mounted in such cramped quarters to fire in all directions?

The big German Gothas carry 1200 pounds of bombs. Suppose the bombs were left behind and just enough fuel carried for a two hours' flight. A lot of weight could be put in armor. We have indicated the armored portions by making them blacker. The wings are a lacework of ribs, so that a shot may pass through them without causing a complete collapse of the framing

For the present, at least, turrets are out of the question. What then? A startling plan suggests itself: *Armor the men in the cockpit.* The press reports of Lufberry's encounter with the flying tank state that the German crew were actually clad in mail. The reason becomes more and more obvious. The men have no time to revolve a sighting slot, which, in itself, limits their field of vision; they have too many other things to do.

The suit of armor worn by each man (a suit of far tougher steel than any 15th century armorer could have produced) must be a full suit. Remember that the bullets may pour in from any side. Body armor is lighter by far than turret armor. Modern science will make it far more flexible than the medieval knight's coat of mail. There is no need for much muscular action in firing a machine gun—scarcely as much as was needed for poising a lance. The mailed knight of the Middle Ages was about as awkward on foot as a penguin on a beach. On a horse he was much like a pilot in an airplane. He had only to guide his horse and charge; the pilot has only to steer his machine toward his enemy. Armor the men in the machine, and the task of aiming and firing a machine gun is not impeded. And so Godfrey of Bouillon, the Chevalier Bayard, the crusaders whom we thought we had buried for good when gunpowder was invented are restored to us again—knights of the machine gun skimming over the clouds of a twentieth century battlefield.

What next? We must evolve a Monitor of the clouds to fight this suddenly created Merrimac. The armored flying machine must be met with the shell fire of a small gun, something like the French thirty-seven millimeter weapon. Such a piece can be carried only on a machine as big as the Gotha. Gone are the old wasp-like tactics. Instead we see a more stately maneuvering for favorable positions. The ranges increase. Against shell fire machines cannot be armored heavily enough. Once the nose-spins, the-side-slipping, the tail-dives, the dodging, the looping, the "dead-leaf" gyrations that now characterize air fighting are abandoned, victory must belong to the more powerful gun, the gun that can shoot accurately for a considerable distance. Guns have always won battles since gunpowder was invented. It is so on land; it is so on the sea; and it is so in the air. But admit this and once more the Zeppelin looms up as an efficient possibility for long-range combat against the sluggish, mammoth cannon planes that are to play the parts of aeriel Monitors. Because of their enormous lifting capacity, because of their immense size, Zeppelins can carry a far more powerful battery than any mammoth steel-clad flying machine. But if the Zeppelin reappears, why should not its old enemy, the wasp-like single seated fighter also reappear? Why should it not be sent against the Zeppelin as it was sent against it so successfully over London?

It is a curious circle in which we find ourselves revolving dizzily. The single seated wasp-like fighter gives way to the armored plane, the Merrimac of the air; the armored plane gives way to the cannon plane, the Monitor capable of repulsing the aeriel Merrimac; the cannon plane gives way to the rigid, gas-inflated Zeppelin; the Zeppelin in turn gives way to the small, elusive, quick-maneuvering single-seated plane. Surely the air navy of the future must be a strange mixture of various types of aircraft.

Who knows but it may become a heterogeneous collection of a few Zeppelins hiding behind a vast army of flying machines, differing in size as well as in construction and armament!

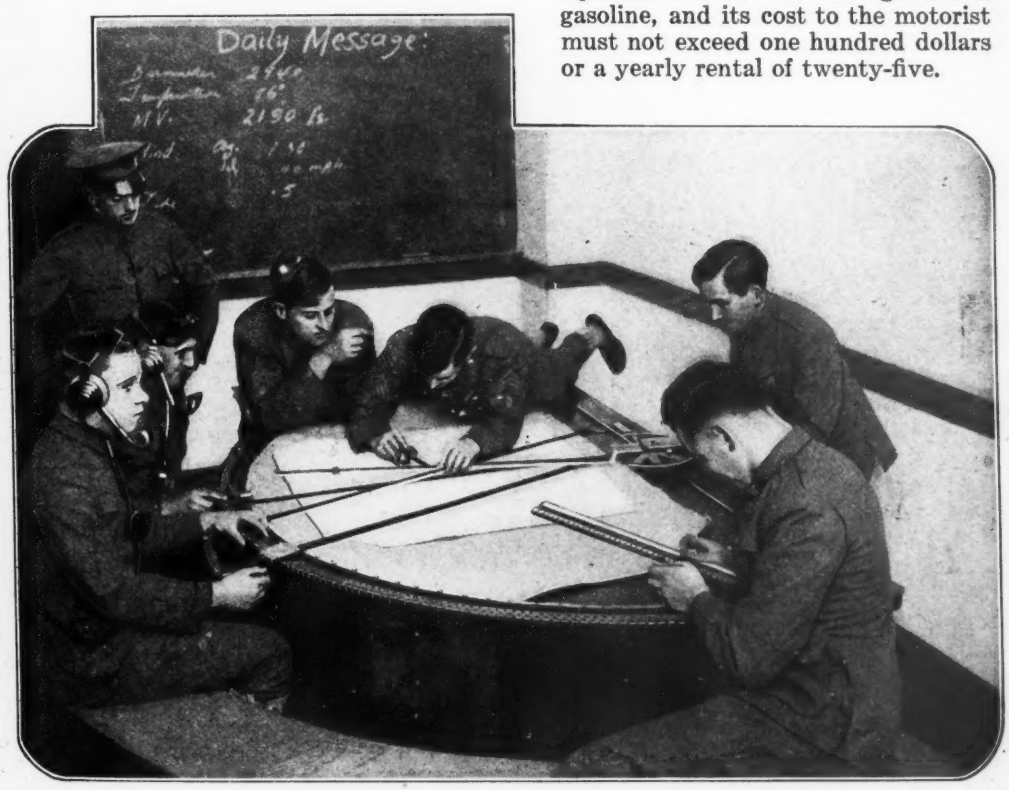
He unbelts himself, rises and leaps from his flaming machine. A bruised almost unrecognizable mass is picked up in a flower garden

Teaching Artillerymen to Handle the Big Guns

LONG range gunnery with the modern high power guns of large caliber is by no means a simple thing to learn. A great deal of mathematics and physics enters into the study of the complicated technical problems which this kind of gunnery presents. Many things have to be taken into account when one of these big guns is to be directed so as to hit a target many miles away. Atmospheric pressure, temperature, direction and velocity of the wind and many other conditions have to be considered.

One of the most difficult problems is the calculation of the curved path of the projectile and the exact determination of the angle of elevation of the gun.

The picture shows a number of artillery students working out problems at the plotting table. The plotting consists in the working out of certain trigonometric problems involved in finding azimuths, locating batteries, etc. The table shown in the picture is a device of great practical value to the directors of artillery fire. By purely mechanical methods it solves in a few minutes, problems, the solution of which without its help would require a great deal more time. This plotting table is being used with splendid results at the Presidio Coast Artillery School, near San Francisco.



The picture shows a class of young artillerymen studying long-range gunnery with the aid of a plotting table and working out various intricate trigonometric problems

$5,000 for Device to Use Coal-Gas as Automobile Fuel

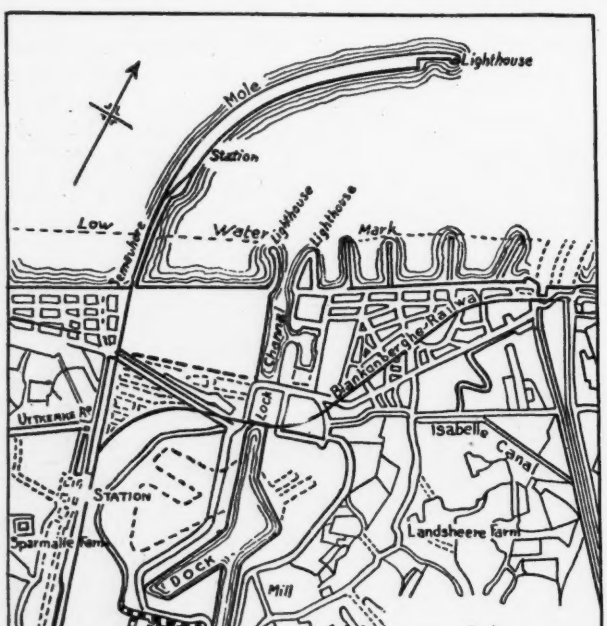
THE Automobile Association and Motor Union, Fanum House, Whitcomb Street, London, W. C., is offering a prize of five thousand dollars to the inventor of a method by which coal-gas can be used as fuel for automobiles. The conditions governing the contest are that the container for the coal-gas must occupy not more than nineteen cubic feet of space, its weight must not exceed one hundred and forty pounds, it must contain the equivalent of two or three gallons of gasoline, and its cost to the motorist must not exceed one hundred dollars or a yearly rental of twenty-five.

How Zeebrugge Harbor Was Bottled Up

By a daring and brilliant naval raid the British closed that German submarine base

DURING the night of Tuesday, April 23, of the present year, a British naval expedition under the command of Vice-Admiral Roger Keyes made a daring raid upon the German naval base of Zeebrugge. The raid was cleverly planned and so brilliantly executed, that important strategical advantages were gained, the most important being the blocking of the ship canal connecting Zeebrugge with Bruges.

Six obsolete cruisers, the *Brilliant*, *Sirius*, *Intrepid*, *Iphigenia*, *Thetis* and *Vindictive*, two Mersey ferryboats, the *Daffodil* and *Iris*, two antiquated submarines, and several destroyers beside a number of motor launches and other auxiliary craft constituted the raiding expedition which was convoyed by several modern cruisers, destroyers and monitors. The *Vindictive* was specially equipped for landing storming parties and carried batteries of Stokes mortars, flame throwers and other means of destruction; the other cruisers were filled with concrete and carried only small crews, all picked from the blue-jackets and royal marines, who had volunteered for the hazardous expedition. These cruisers were to be sunk in the harbor of Zeebrugge so as to block its channel to the German submarines which used the harbor as their base.



Map of Zeebrugge harbor, showing the mole and the canal, now blocked, connecting the harbor with Bruges, strong German base and important distributing center

The night was dark and starless and the sea in the channel choppy when the raiding expedition started on its journey. Shortly after midnight the light at the end of the mole which protects the harbor of Zeebrugge was sighted and, almost at the same time, the Germans sighted the approaching British fleet. A moment later star shells were fired by the German batteries and the mole as well as the approaching fleet was brilliantly lighted by many search-lights from the shore.

This was the signal for a terrific bombardment. The British monitors and cruisers opened fire upon the defenses and the important buildings of Zeebrugge and continued their bombardment for an hour, while the Germans showered a hail of projectiles of various calibers upon the raiding fleet and the British and French cruisers and monitors which were supporting them.

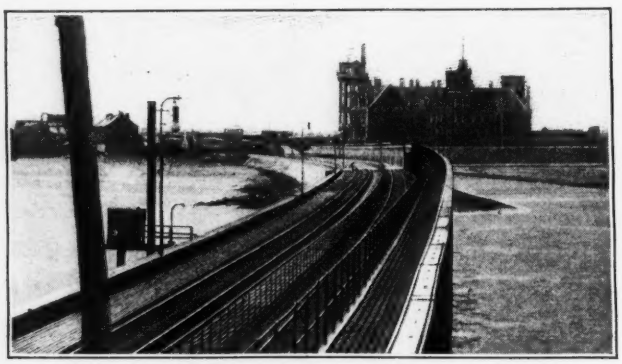
During the progress of the bombardment the British raiding cruisers, under the cover of a smoke screen, continued their way toward their objective points. The *Vindictive*, accompanied by the *Daffodil* and the *Iris* had almost reached

Bird's-eye view of the successful British raid upon the German submarine base at Zeebrugge. Note position of blocking cruisers and how the Daffodil held the Vindictive against the mole

the mole unnoticed, when the wind shifted, disclosing them to the Germans. Notwithstanding the terrific fire which the German guns of the coast batteries directed upon the ships, the *Vindictive* steamed up to the mole and, with her bow toward the shore, anchored alongside the stone structure of the mole which extends in a curve to a distance of more than 8,000 feet. The stone work of the

mole protected the lower part of the *Vindictive's* hull, but her superstructure, the bridge, deck cabins and smoke stacks were riddled and torn by hundreds of shells and other projectiles fired at comparatively short range.

While the *Daffodil*, headed at right angles to the mole, pressed with her bow against the starboard side of the *Vindictive* to hold her against the stone wall, the cruiser landed a storming party of five hundred men armed with hand grenades and Lewis guns. The raiders were attacked by a force of German marines and in the desperate hand-to-hand struggle many were killed. The British blue-jackets disabled several big German guns and did other damage during the hour which elapsed before the survivors were ordered back on board. The principal object of landing the storming party was to create a diversion that would detract the attention of the Germans from the main feature of the raid, the blocking of the channel.

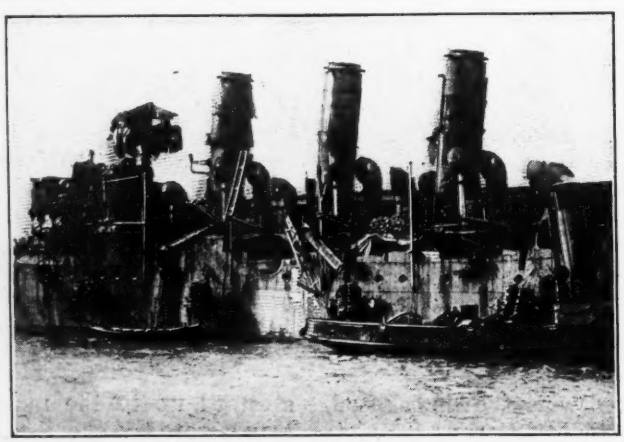


Looking toward the shore end of the Zeebrugge mole. Connection with the shore is cut off by a gap of 120 feet

Practically unobserved, three of the blocking cruisers, accompanied by one of the old submarines, loaded with powerful explosives, and a few motor launches rounded the end of the mole and steamed into the harbor, followed by two destroyers. The searchlights of the Germans soon "spotted" them and the harbor batteries received them with a furious fire. The *Thetis* ran aground before she had reached her objective point, but the *Iphigenia* and the *Intrepid* made their way to the entrance of the Bruges Canal. The *Iphigenia* destroyed a steam dredge in the channel before she was sent to the bottom and the *Intrepid* was sunk in a position so as to close completely the entrance to the canal.

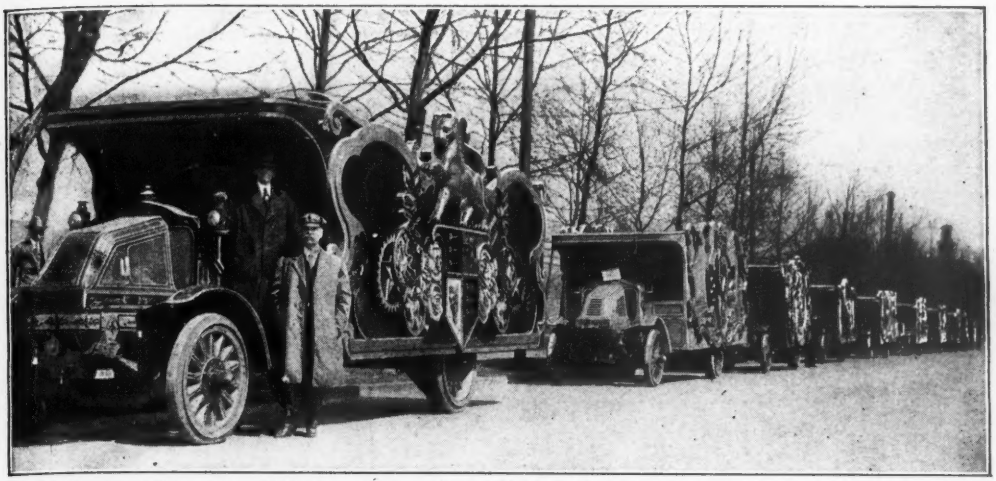
The submarine, guided by one of the destroyers, made its way toward the pile trestle connecting the stone mole with the shore. It was wedged between the piles and abandoned by the crew, after they had set the time fuse which was to set off the explosives in the hold. The men, like the survivors of the crews of the *Iphigenia* and *Intrepid* were picked up by some of the motor launches and later transferred to a destroyer. Two minutes after the British submarine had been abandoned by her crew, the explosives in the hold blew up with tremendous force, making a gap of 120 feet between the mole and the shore. Many German marines on the trestle at the time were killed by the explosion.

The object of the raid being gained, the signal for withdrawing was given by the commander. The remaining ships withdrew under the furious barrage fire kept up by the German batteries and returned safely to their base.



© Underwood and Underwood

When the Vindictive returned to her base her upper works were riddled by the terrific fire of the Germans



A glimpse of the automobile circus procession—it's fifty city blocks long. Each vehicle is decked out like Solomon in all his glory. Why motor trucks? To reach towns off the railway lines

Solomon in All His Glory Was Not So Glorious as the Motor Circus

THIS is to inform prospective patrons that what the press agent calls the "great, grand, gorgeous, glittering, gigantic automobile circus," which POPULAR SCIENCE MONTHLY told about a year ago, is again making its way through the country with "six hundred thousand dollars' worth of pure gold leaf on one hundred and fifty motor trucks." The whole circus is being transported in automobiles, including the menagerie, the kitchen and the sleeping quarters for the show folk.

The trucks are driven by engines of one hundred and fifty horsepower each. The procession extends for fifty city blocks. Gasoline and oil follow the caravan in tank cars, and caterpillar tractors are on hand to pull the trucks out of ruts. Each car is driven by a sixty-horsepower engine.

Jumps limited to thirty miles a day are being made, so that remote hamlets which have been denied the privilege of seeing a circus can be visited. However, the circus employees of the old school, who drove immense vans drawn by horses, will be missed, their places having been taken by chauffeurs.

The circus began its tour from Toledo, Ohio.

A Sammy Wears Nine Pairs of Shoes a Year

THE shipments of shoes for our forces in France, according to General Pershing's demands, aggregate 18,590 pairs for each 25,000 men a month, or about nine pairs a year for each man. This large supply is to continue only until a reserve store has been accumulated. A total of 15,437,000 pairs of shoes have so far been received or contracted for by the Quartermaster-General's department.

Sticks Give Way to Reel and Line in Marking Out Garden Rows

IF you happen to observe your neighbor marking out rows in his garden by the time-worn method of employing two sticks at the ends of a string, tell him that he can save time and energy by using a means devised by J. F. Hatch, a fertilizer clerk in the North Carolina Department of Agriculture. It is described as the "garden reel and line."

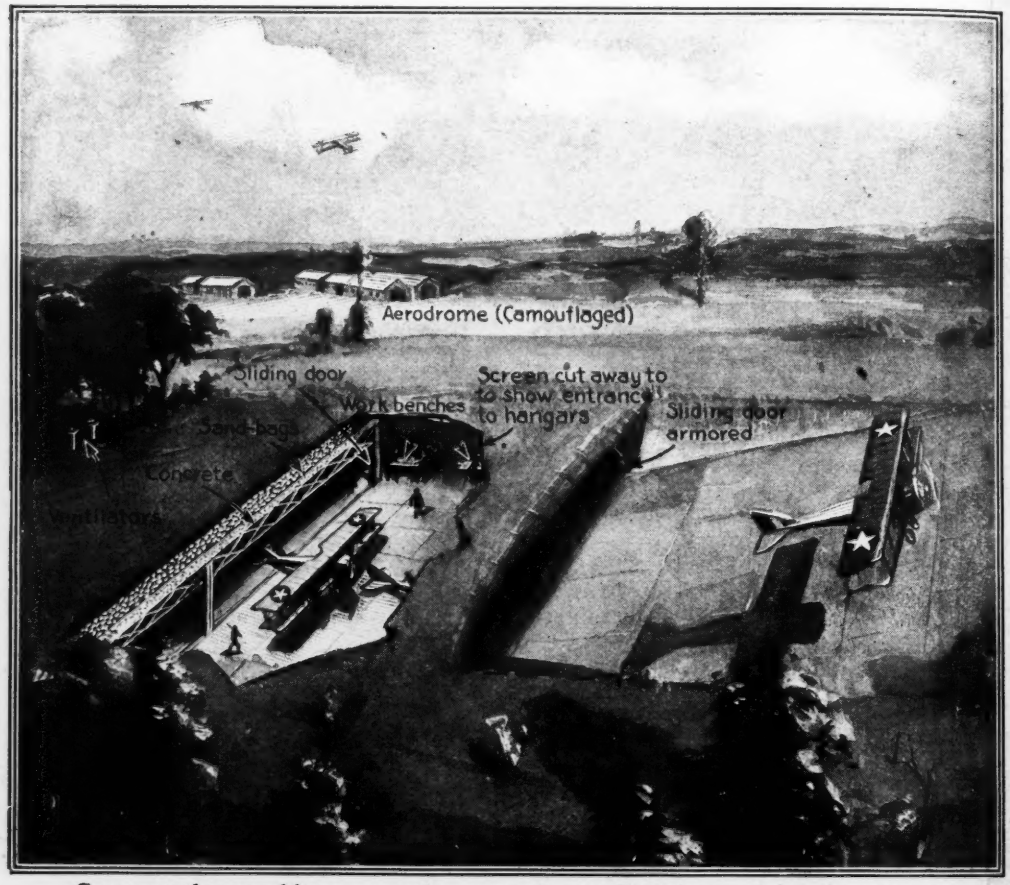
This is the way it operates: The thread is kept on a spool which unwinds as the garden-maker walks. The unwinding of the thread is stopped by pushing in a catch on the ratchet wheel at one side of the device.

The reel and line used in marking out garden rows with method

The Airplane Becomes a Mole

A single bomb can do more damage to a flying machine than a day's fighting in the air. Hence the underground hangar appears

By Carl Dienstbach



German underground hangars on the western front. The picture shows the entrance with the elaborate precautions taken to conceal and protect the machines from bombs

THE military airdromes with their hangars and repair shops near the fighting front rival railway stations in tactical importance, and, for that reason, are favorite targets for the enemy's airbombs. More airplanes are destroyed in their hangars by one successful bombing raid than in many days' fighting in the air. The destruction or damaging of repairing and "tuning up" facilities is also a serious matter. Hence it is not astonishing that the Germans are now housing their airplanes under ground.

It soon became clear that hangars at the front would have to be built underground like those in a fortress within range of the enemy's shells. But hangars cannot be put underground as easily as barracks or munition magazines. Airplanes, with their enormous wings demand a great deal of space and cannot easily be stowed away in a hole in the earth.

Large, and at the same time unobstructed underground spaces would necessitate very elaborate and costly supports for the ceiling. They also would have to

be placed at a great depth to make the roof bomb-proof. This would, in turn, make it necessary to construct a deep, long inclined open ditch by means of which the airplanes get in or out. Such a ditch would be hard to dig and would be easily clogged by the enemy's bombs or shells.

The most practical and most economical form for an underground hangar is a long tunnel, just wide enough to accommodate a single file of airplanes. This form is necessary to give to the roof the greatest possible strength to resist bombs, without using too expensive a construction of girders and without going too far underneath the surface. The runway ditch, leading gradually down into the hangar, must have slanting side walls to give it strength to resist the effect of bombs. The floor and the sides of the ditch should be covered with a continuous layer of one-inch armor plates. Sliding doors armored with two-inch steel plates and running on ball-bearing rollers on tracks must be provided.

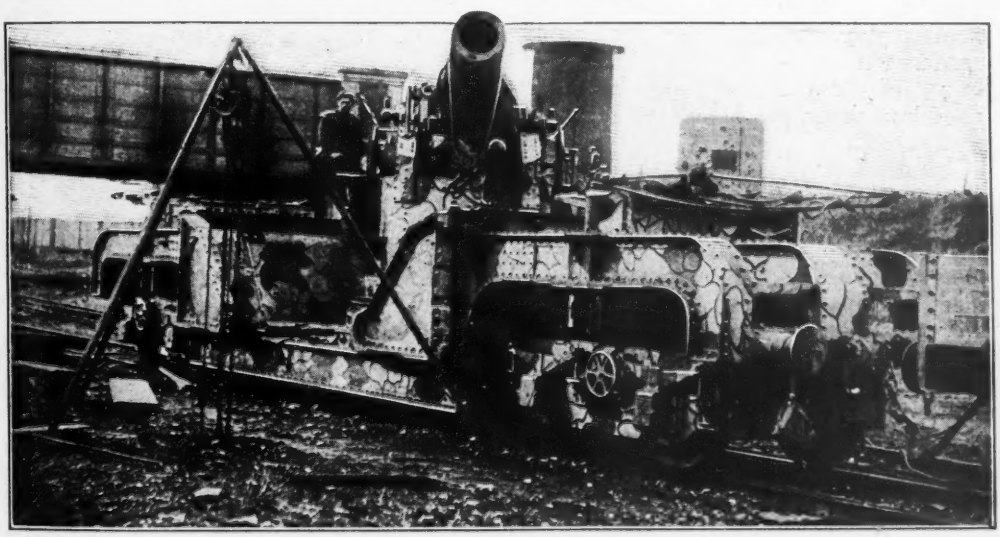
To ventilate the hangar, air shafts should be provided, leading to high chimneys some distance from the underground structure. This is necessary in view of the fact that the hangar in its side galleries gives shelter to the repair shops, forges and magazines as well as to the living quarters of the men who work in it. The interior must be supplied liberally with electric light and drinkable water.

Making Believe with Paint and Brush at the Front

THE observer in the airplane tries in vain to locate the enemy gun; his eye, looking through a telescope, fails to detect its muzzle through the foliage. So he flies away and the gun is not attacked.

This is an example of camouflage as it is practiced in the European war. And the camoufleur is so expert that his business of fooling the enemy has become an art.

An early use of camouflage by the French was the application of paint to big guns in order to make them resemble the foliage in which they were partly concealed. However, when the guns had to be placed in the open the disguise only accentuated their visibility. The protective coloration of birds and animals gave a hint to the camoufleurs who saw that it disguised the outlines of these creatures and counteracted to a considerable degree their undershadows. So the high lights along the gun barrels were darkened and their under surfaces lightened. The colors of the paint, of course, harmonized with the surrounding objects. The finishing touches to this work consisted in irregular streakings and blotches which broke the outlines and at least confused the observer if they did not serve to produce invisibility.



This big British gun is being made ready for the front with the aid of brush and paint applied by artists, who make it appear as part of the landscape

Link Buttons That Keep Cuffs Up to Avoid Soiling Them

THE wearer of the new link cuff buttons can raise the cuffs as high up the arm as he pleases—to any position. The links automatically open when the cuffs are raised and close when they are lowered.

Attached to the links are two small parallel wire arms with oval buttons on the cuff ends and a small flat spring with retaining clasps on the other end. The links form a V-shaped device that spreads apart when the cuffs are raised on the forearm and is drawn together by the spring when they are lowered. The cuffs are kept in the place desired by the clasps which grip the sleeve.

These link buttons prevent the cuffs from being soiled

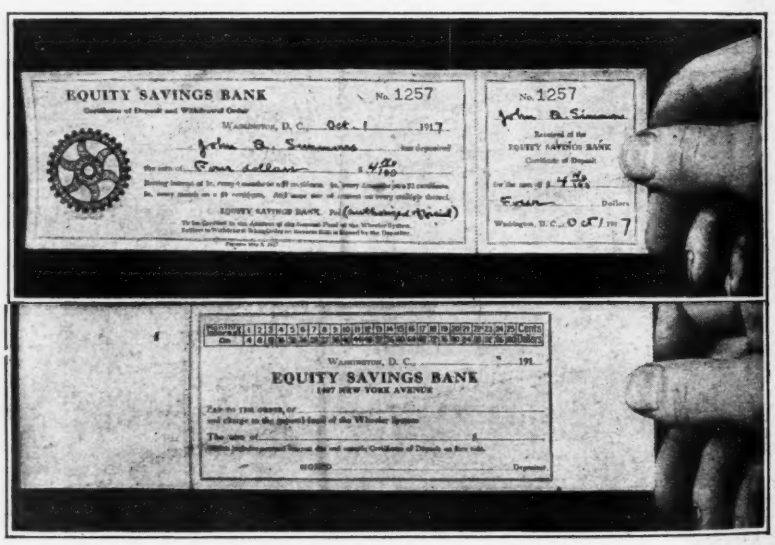
Making the Small Checking Account Pay. A Bank Problem Solved

THE invention of the unique form of check (herewith reproduced) is due to David B. Wheeler, a machinist by trade. It does away with costly bookkeeping and renders the handling of small checking accounts profitable.

When making a deposit, the depositor fills in all the blanks on the face of the check except that for the official's signature. He then hands the book to the receiving teller, together with the cash. The teller receives the money, signs his name and tears off the stub to keep as his record of the transaction and receipt from the depositor for the certificate of withdrawal.

The check now becomes a potential certified check. To convert it into cash at any time it is only necessary for the depositor to fill out the reverse side as is shown in the illustration. Actual experiment has demonstrated that these checks are honored not only by the banks and clearing houses, but that they are accepted by merchants as if they were cash. The cancelled check eventually finds its way back to the bank of issue where by means of the serial number it is matched up with the stub and the transaction is completed.

By the ingenious device of issuing these checks in the sums of one, two, four and multiples of four dollars, it is possible to reckon and pay interest. This unique combination of check, receipt, certificate of deposit and withdrawal order, invented by Mr. Wheeler, constitutes the Wheeler system of accounts, which has been successfully used by the Equity Savings Bank of Washington.



The face and reverse side of the check invented by Mr. Wheeler, which has been adopted by a Washington bank and used with marked success

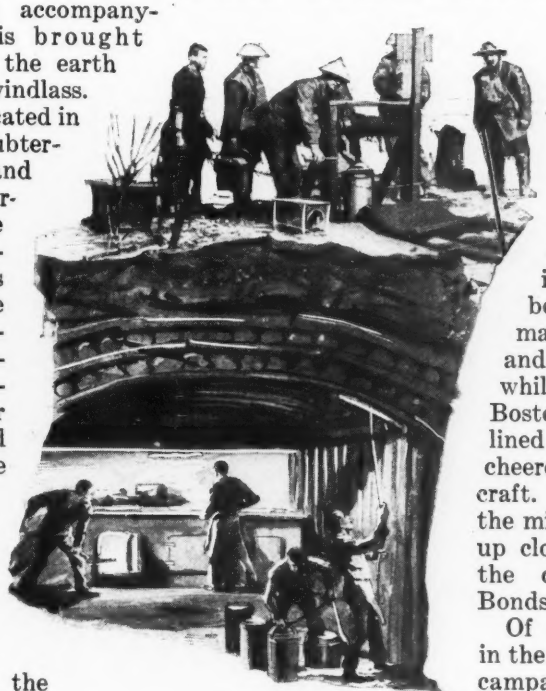
Cooking Under the Ground for British Soldiers

THE life of a British soldier in France is not made up entirely of dodging shells and bullets and going "over the top." He spends some time in looking out for the inner man. For he has learned that a soldier does not fight well on an empty stomach and that properly cooked food is essential to efficiency.

Food can not be safely prepared in positions exposed to the fire of the Germans. The cooks might be driven away from the stove by the concentrated fire of machine guns at a critical period in the broiling of the meat.

Therefore the underground kitchen was built. It has many of the conveniences found in the home of the careful housewife and some features which her kitchen does not possess. For example, the food from the underground kitchen shown in the accompanying illustration is brought to the surface of the earth by means of a windlass. This kitchen is located in a bomb-proof subterranean chamber and although the Germans raked the surrounding sections with shells and bullets, the culinary arrangements of the British remained undisturbed. After the Germans had retreated the British received the food that had been prepared.

The picture at the right gives a good idea of the construction of the underground kitchen with its dumbwaiter.



British soldiers hauling up food from an underground kitchen

© Int. Film Serv.

These cleverly camouflaged miniature warships made a great hit during the Liberty Loan campaign in Boston

Miniature Warships Aiding in Liberty Loan Campaign

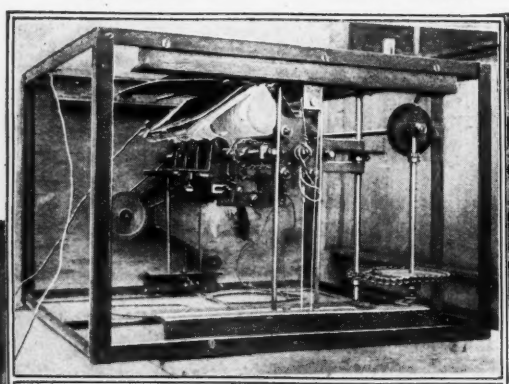
ONE of the many interesting features of the last Liberty Loan campaign in Boston was the use of miniature copies of a torpedo boat and of a submarine on the Charles River basin. Both ships were manned by United States sailors and attracted considerable attention by their camouflage coloring. The torpedo boat, towing the submarine, cruised back and forth in the basin, while large crowds from Boston and Cambridge lined the banks and cheered the oddly painted craft. From time to time the miniature warships ran up close to the bank and the crews sold Liberty Bonds from the deck.

Of all the devices used in the Third Liberty Loan campaign this was the most novel, inspiring and appealing.

Doing It with Tools and Machines

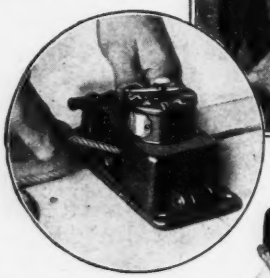
Magnetic chucks cause the parts machined to become magnetized. This device neutralizes the magnetism

This book fumigating machine turns the leaves by an electric motor so that the fumes reach the whole surface

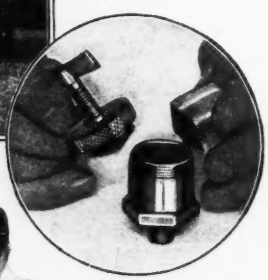


Steel drawers in a steel rack to hold heavy articles. The picture shows their strength

A wagon trailer leader for loading grain sacks. It is operated by a small gasoline engine



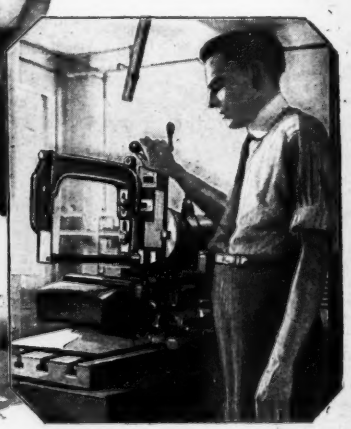
Drawing the rope through this machine measures and registers it up to one hundred feet



A grease cup which is supplied with grease held in paper capsules

A swage with oval die, for use on large saw teeth

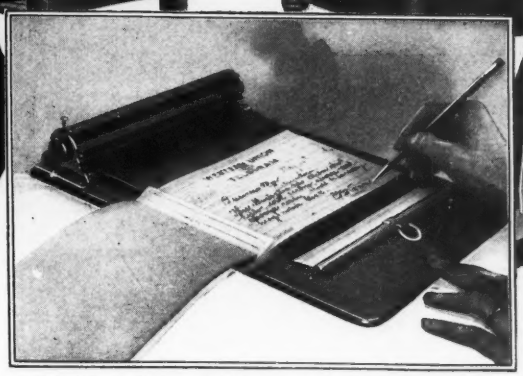
This grinder has oil stones for sharpening wood-working tools



Hacksaw blades are used on this frame attachment

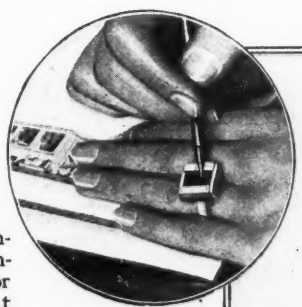
Saving Time and Labor in the Modern Office

A table constructed for use with a calculating machine. The table has a sloping top



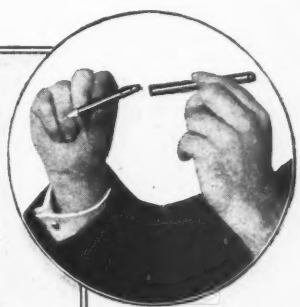
Carbon sheet holder constructed on the principle of the ordinary curtain shade roller

A compactly built addressing machine designed for the addressing of shipping tags



Rubber pen-wiper on a finger ring for helping out the draftsman

A roll holder for gummed labels which are to be marked by the typewriter to which it is attached

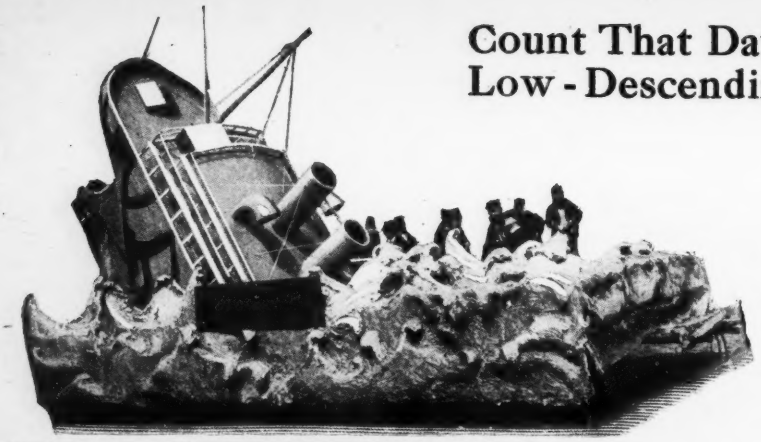


Pencil holder that holds short pencils

A chair suitable for school, lecture or lunch room. Has one wide arm rest

This little machine rewinds your typewriter ribbon without soiling fingers

Count That Day Lost Whose Low-Descending Sun Sees

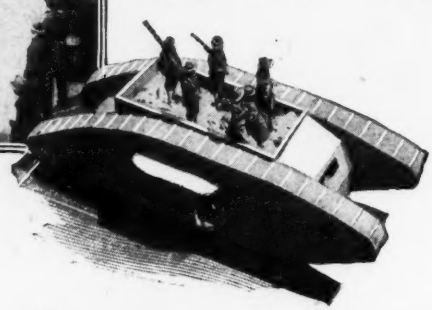


One of the realistic floats in New York's Liberty Loan parade, which attracted unusual attention and applause

A Thrift Ship manned by school children was one of the most successful features of the recent parade at Los Angeles, Cal.

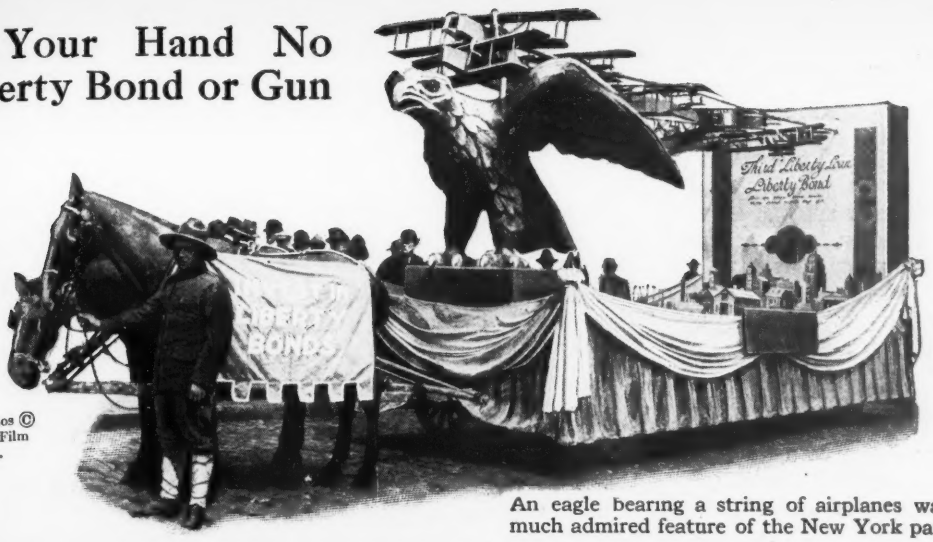
Leo Dulmage, the heavyweight champion unicycle rider of the world, assisted the Liberty Bond drive in New York city

The imitation of a British tank in the children's pageant in Los Angeles strongly appealed to the crowds of cheering spectators



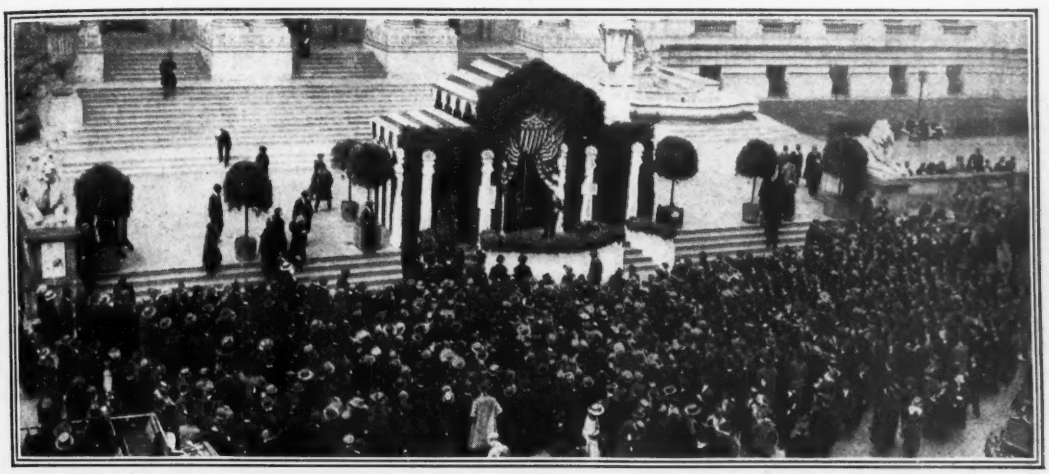
The picture above shows the first floats leading the great Liberty Loan Parade at the last drive in Greater New York

in Your Hand No Liberty Bond or Gun



Photos © Int. Film Serv.

An eagle bearing a string of airplanes was a much admired feature of the New York parade



The picture shows the speakers' stage in front of the New York Public Library during a Liberty Loan rally. Many thousand persons heard the speakers during the campaign

The Thrift Ship of the Los Angeles school children crossing the famous winding viaduct over the Arroyo Secco

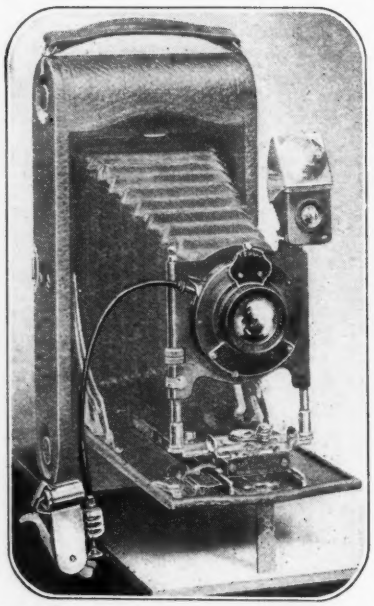
A pavilion in the shape of a large bell formed the background for the speakers in City Hall Square, New York

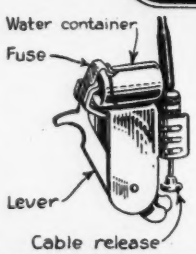
The Camera Man Gets into the Group Picture

"YOU ought to be in this photograph," is frequently said to the amateur photographer when he is showing a snapshot that he has taken. He could be in the picture, even if it is a snapshot, if he were to use a device which has recently been introduced.

The invention is attached to the cable release of the camera, as shown in the accompanying photograph. The cylinder-shaped container is filled with water and a wick made of cotton inserted in it to convey moisture to a strip of blotting paper which is used as a "fuse." The blotting paper is passed through a holder so as to come in contact with the wick and absorb the moisture. A lever forced downward by a spring operates the cable release, being held by the "fuse" in the position in which it is shown.

When the camera is ready to be snapped the "fuse" is inserted in the holder and the water from the wick gradually soaks through the blotting paper till it becomes pliant and permits the lever to be forced downward and actuate the cable release. Between fifteen and twenty seconds elapse between the insertion of the "fuse" and the operation of the camera shutter, giving the photographer ample time to take his place in the group to be photographed.





The device attached to the cable release permits the photographer to "get in" the picture

Water moistens the "fuse." This becomes so soft that it allows the lever to be forced downward by a spring

A Machine That Strips Tobacco Rapidly

A MACHINE invented by William H. Seaver of Agawam, Mass., not only strips tobacco faster than is possible by hand, but at the same time it cuts the stalks into lengths suitable for use in fertilizing the ground.

The stalks, fed by hand between two wheels, pass between the stripping wheel and a belt. The stripping wheel and the belt move slightly faster than the feed wheels, and as a result the leaves are pulled from the stalks and deposited at one side of the machine.

Continuing to pass through the machine after they have been stripped of their leaves, the stalks are drawn between a plain wheel and a wheel set with knives and cut into three-inch lengths. They are then ejected through a chute into a pile behind the machine.

The machine is operated by a gasoline engine and is installed on a light truck

This machine strips tobacco and prepares the stalks for fertilizing land at the same time

You Cannot Lose or Misplace This Collapsible Funnel

"THERE is a spring—let's stop there for a drink!"

At this suggestion of his companion the man driving the automobile steered his machine to the side of the road and stopped within a few yards of the spring.

"Now we should give a drink to our horse," jokingly suggested the driver's companion, after they had refreshed themselves.

"That's exactly what we'll have to do if we want to avoid trouble," answered the other. "The water around the radiator is nearly boiled away."

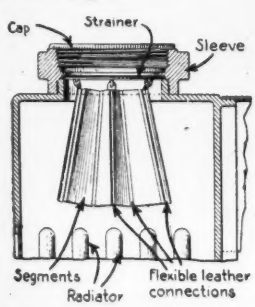
"Well, there is enough water in this spring," remarked his companion, "but it puzzles me how you can get it into the cooling jacket. Surely, you don't expect to fill the tank by pouring in the water with our drinking cups?"

"You shall see in a minute," said the other, producing a collapsible canvas bucket, which he handed to his friend.

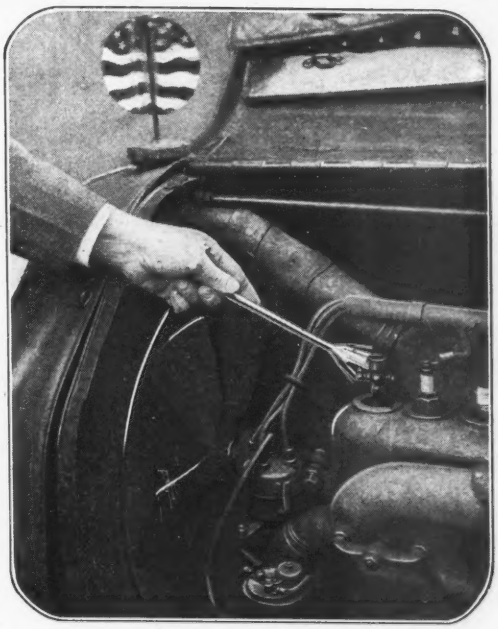
"While you fill this, I'll unscrew the cap and get things ready for filling the tank."

Cautiously he unscrewed the cap which was still uncomfortably hot. Then he unscrewed the strainer set in a double-threaded ring which covered the opening to the cooling tank. When he turned the contrivance upside down, the collapsible funnel, which had been hanging limply inside the cooler, unfolded by gravity and formed a large funnel.

The device, an invention of Harry S. Welsh of New York, consists of a number of metal segments connected by flexible hinges of leather or some other material, so as to form a cone or funnel when expanded by their own weight.



A collapsible funnel attached to the cap of the cooling jacket



It will not soil your hands to turn the cocks or grease-cup of forward spring pin

Making It Easy to Turn the Grease-Cups of an Automobile

THE grease- or oil-cups of an automobile need attention from time to time. This adjustment is one of those disagreeable duties that every automobilist has to perform. It is particularly exasperating that the oil-cups are never so rebellious as when the driver is wearing his best clothes. A handy little grease-cup wrench, which has recently been placed in the market, will be a great help to automobilists in such emergencies. With the aid of this wrench, which has a long handle and fits any size or shape of grease-cup or cock, he can reach any refractory cup or cock and turn it without soiling his fingers and cuffs. Primer cocks, drain cocks and pet cocks are as easily operated on with the wrench as are grease-cups.

This little tool is a handy thing to have in your tool kit.

Running Your Car with Push-Buttons

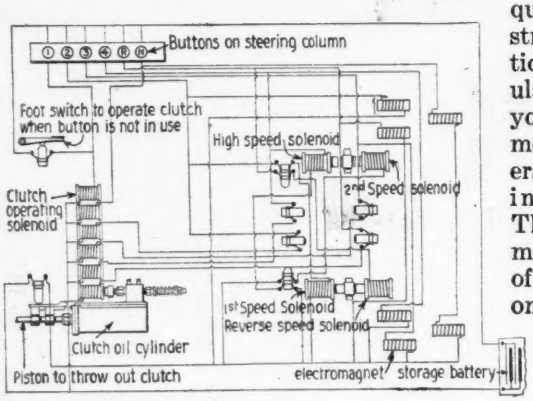
The device that won the Popular Science Monthly's automobile labor-saving contest. No effort required to shift gears or to push down on the clutch pedal

As promised last month we publish a description and pictures of the electrically-operated gear-shifter with an automatic clutch throw-out which was invented by Mr. C. A. Butterworth of Newton Center, Mass., and which won the first prize in the POPULAR SCIENCE MONTHLY contest for the best ideas on labor-saving automobile devices.

Its use eliminates the physical exertion expended in the present type of car every time it is necessary to shift gears and in addition does away with the physical labor required of the foot to push down on the clutch pedal and disconnect the engine from the driving mechanism each time the gears are to be shifted.

In brief, the electrically-controlled gear-shifter is made up of a series of solenoid switches which are opened and closed at will by means of interconnected switch buttons arranged in a small case on the steering column so that only one switch can be closed at any one time. There is one switch and button for the neutral position of the gears and one for each of the forward speeds and one for reverse speed. As soon as a switch is closed, the circuit electrically opens a small valve in a little oil cylinder near the clutch housing. The opening of this valve permits the oil to flow into the cylinder from the pressure oil tank which forms a part of the equipment and the oil in turn forces a piston in the cylinder forward until the clutch is thrown out. At the same time that the clutch circuit is closed, a second circuit is closed through a solenoid to operate a bar controlling the intake valve to one of two oil cylinders fed from the same oil pressure tank as the clutch throw-out cylinder. One of the two oil cylinders serves to shift two of the forward gears by the movement of its piston, and the other cylinder and its piston serve to shift the reverse gear and the third forward speed gear in case of a three-speed and reverse gearbox. When the oil in either cylinder has forced the piston out sufficiently to shift from one gear to the next, a stop on the piston rod strikes a contact point and breaks the circuit holding the clutch piston out of its cylinder so that the exhaust valve on the cylinder is opened. The clutch spring then tends to force back the piston, but as the exhaust port is considerably smaller than the inlet, the oil escapes slowly and thus permits the clutch to come into contact gradually. The change from one gear to any other is made in a similar manner according to the button pressed. The arrangement of the solenoids and oil cylinders is shown in the illustration opposite and the wiring diagram on this page.

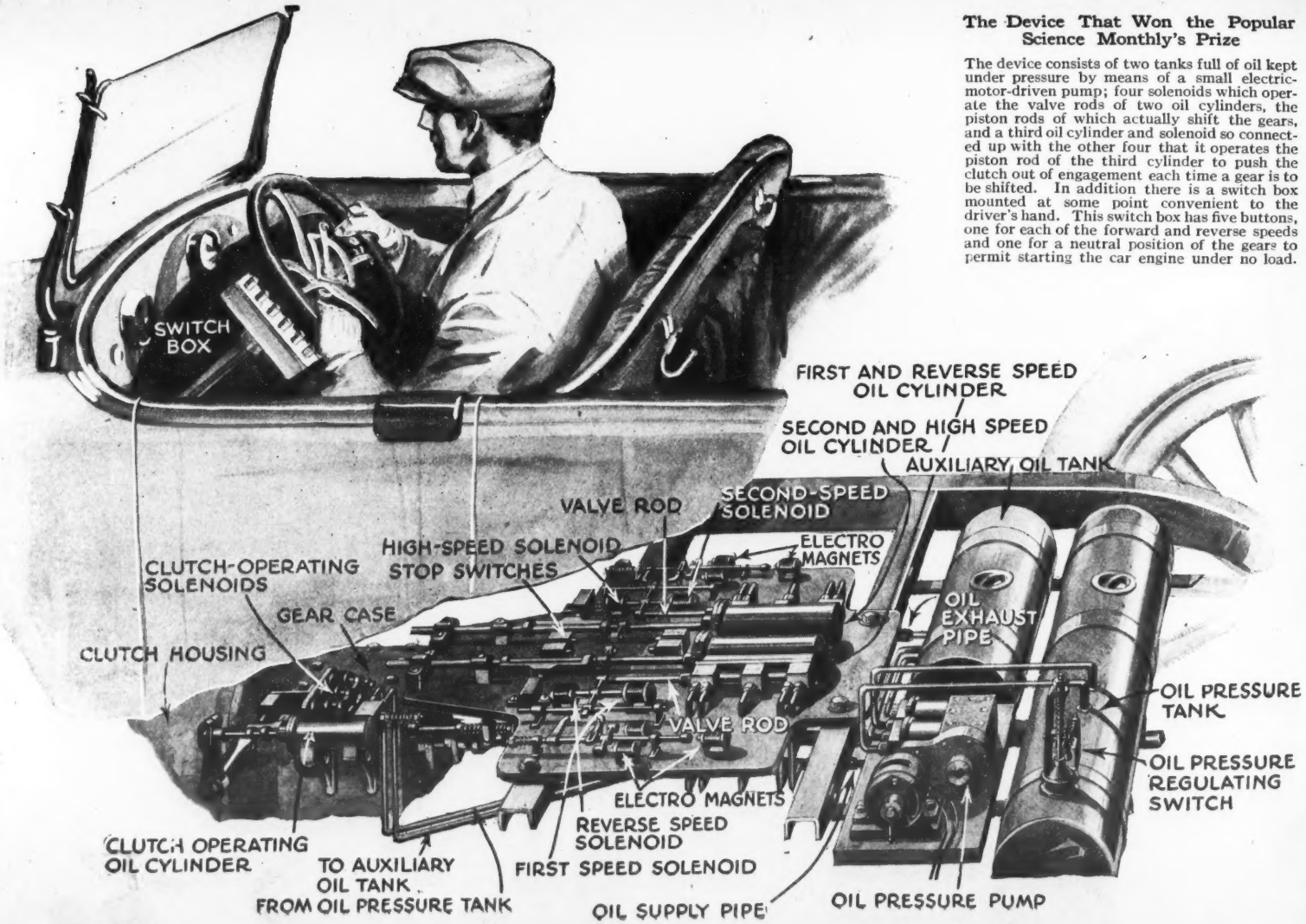
Picture to yourself how much this invention, if embodied in the mechanism of your automobile, would add to your comfort in driving. Instead of doing hard physical labor every time it becomes necessary to change the speed you run your car, accelerate its speed, retard or reverse it simply by pressing a little button. To produce these changes requires scarcely more strength and exertion than to manipulate the keys of your typewriter. No more pushing of levers, no more throwing of clutches! This would, indeed, mean a great saving of labor, as every one familiar with the driving of an automobile will know and most thoroughly appreciate.



Arrangement of solenoids and the wiring in Mr. Butterworth's prize-winning invention

The Device That Won the Popular Science Monthly's Prize

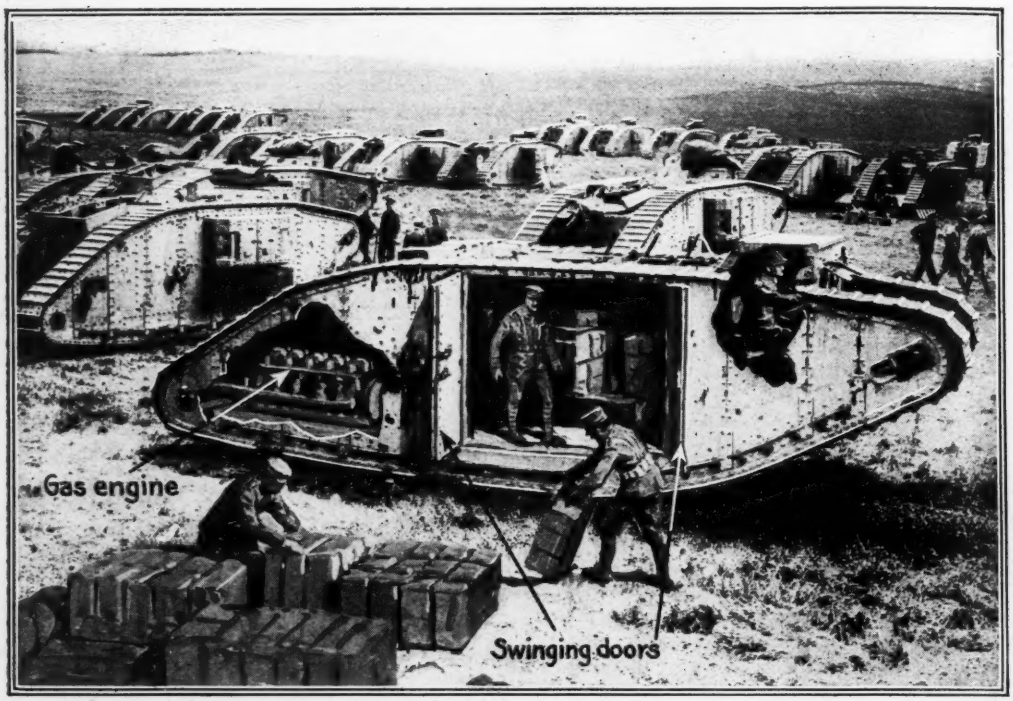
The device consists of two tanks full of oil kept under pressure by means of a small electric-motor-driven pump; four solenoids which operate the valve rods of two oil cylinders, the piston rods of which actually shift the gears, and a third oil cylinder and solenoid so connected up with the other four that it operates the piston rod of the third cylinder to push the clutch out of engagement each time a gear is to be shifted. In addition there is a switch box mounted at some point convenient to the driver's hand. This switch box has five buttons, one for each of the forward and reverse speeds and one for a neutral position of the gears to permit starting the car engine under no load.



Now Comes the Cargo-Carrying Tank

It crawls across country so as to avoid the fire to which roads are subjected at night

By Joseph Brinker



A British tank on the western front being loaded at the base, some distance back of the line, for its journey to the trenches

EXCEPT in great offensives or retreats such as have taken place this spring, it is said on good authority that more men are killed every night in bringing supplies to the trenches than by fighting. This follows from the fact that the troops are fairly well protected in the trenches when under rifle or machine gun fire and in their deep dugouts when the artillery is in action.

Supplies are brought up as near as possible to the front distributing points by means of motor trucks and horses and then carried across the open fields or in communication trenches by men who have practically no protection against shell splinters or machine gun fire. The enemy knows the roads by which supplies are brought up because of the information secured by his airplane observers. He plots every yard of a transport road accurately on his maps and then distributes his artillery in such a manner that it has the range down to the last few feet. Even though the roads are generally protected by cleverly camouflaged canvas screens hung on poles, trained observers in airplanes can detect these subterfuges and get sufficient information to enable the roads to be charted with great precision.

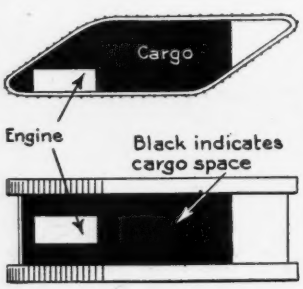
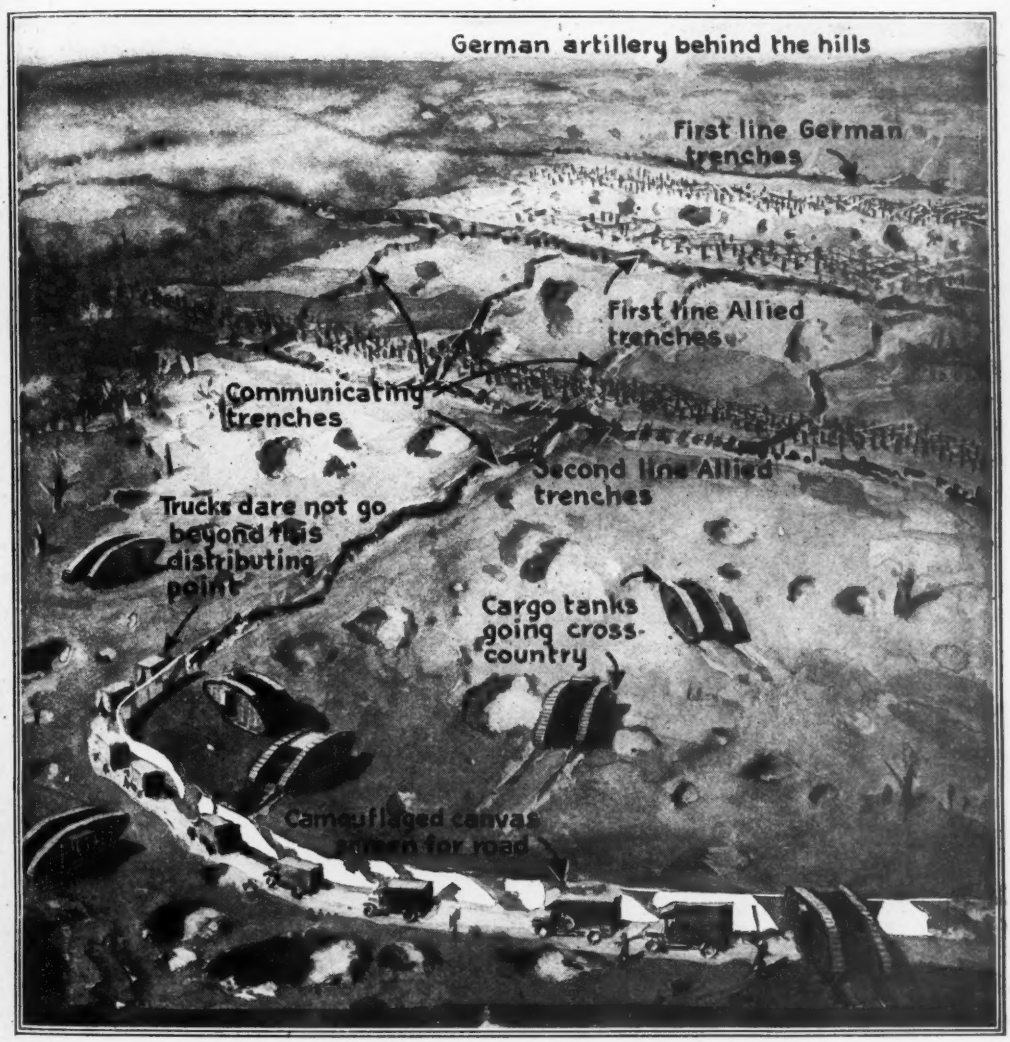


Diagram showing relative space given over to freight

On nights when the enemy has reason to believe that supplies are being brought up, such an intensive fire is rained on these roads that many men, horses and motor trucks are wiped out. Even if there is no slaughter the road is impassable, so that no supplies can be moved forward.

Now comes the cargo-carrying tank, which offers a means of avoiding this great loss. It is not confined to the roads for its progress, but can plow ahead over soft ground, hard ground, and even shell craters or débris which would instantly stop the advance of any ordinary type of wheeled vehicle. To prevent the bringing up of supplies by cargo tanks, the enemy would have to lay down a barrage many miles long instead of concentrating on any certain roads. Such a barrage would be extremely costly, since the cargo tanks could always select a safe sector for their journey. Even if the area in which the tanks are operating were being shelled, there would be no such loss of life as hitherto, since the tanks would be armored only slightly less than at present. They would be immune to rifle and machine gun fire and splinters and could be put out of action only by a


German artillery behind the hills
First line German trenches
First line Allied trenches
Communicating trenches
Second line Allied trenches
Trucks dare not go beyond this distributing point
Cargo tanks going cross-country
Camouflaged canvas screen for road

A bird's-eye view of a section of the battle front showing how the cargo tanks would cut across country and avoid the open roads

direct hit and not necessarily even then, for shells are known to have passed clear through tanks and exploded on the other side without killing one of the crew.

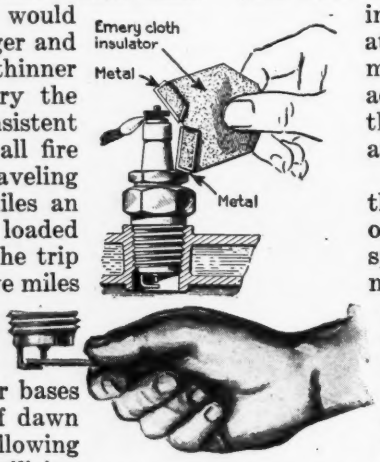
The cargo tanks would not differ materially from the present British tanks in principle. They would probably be a trifle larger and protected with slightly thinner armor in order to carry the maximum tonnage consistent with protection from all fire except direct hits. Traveling at from two to six miles an hour, they could be loaded in advance and make the trip of from six or even twelve miles to the rearmost trenches, be unloaded, turn around and work their way back to their bases before the first ray of dawn was breaking on the following morning. And by utilizing the space usually given over to the machine guns, parts, ammunition and twenty-hours' rations for the crew, regularly carried by the fighting tank, at least five tons of goods, or perhaps more, could be transported by each tank. This is as much as is carried by the average motor truck transport, and as much as by two hundred men carrying fifty pounds apiece.

The illustrations show how British tanks are being actually used to carry supplies on the Western front and how they cut across country where motor trucks would be mired.

Combination Spark Plug Tester and Cleaner

MADE of two heavy pieces of emery cloth glued together at one end with two rectangular pieces of copper inserted between the layers at the other, the handy automobile accessory shown in the accompanying sketches serves the dual purpose of testing and cleaning spark plugs.

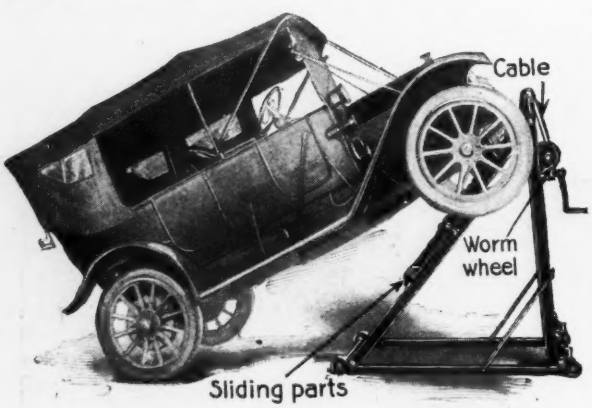
The cloth is cut in a V at the end where the two pieces of copper are inserted. The spark jumps between the inner ends of the two pieces of copper which may be moved closer together or farther apart to determine the value of the spark by the gap it will jump. The cloth end will clean the terminals.

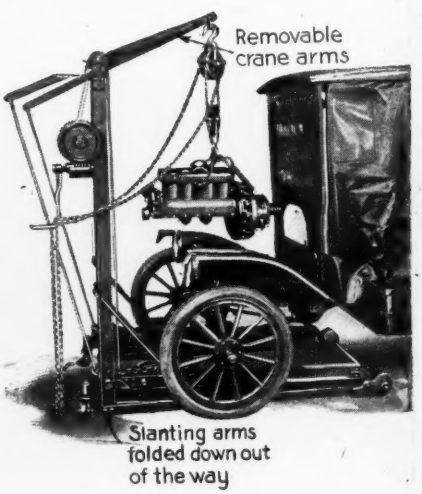


One end of the device is used to test the spark, the other for cleaning terminals

Now It's a Crane and Now a Hoist

WHEN the device shown here is used as a car hoist, the sliding pieces on the arms which engage the car-body are moved up and down by worm-geared wheel operated by a crank. Folding down the slanting arms, and mounting two lifting arms pivoted at the top, changes the device into a crane. It will lift the car off the ground.



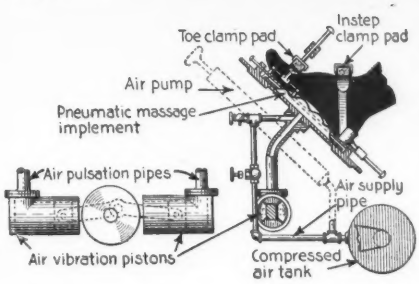


Note how easily this convertible crane-hoist lifts the car off the ground so as to make repairs or cleaning easy

A Massaging Machine Replaces the Hand and Never Tires

AN apparatus that massages like a human hand is designed by the inventor, William C. J. Guilford, of Harrison, Me., to cure fallen arches. The human hand is resistant and yet yielding; it works fast or slow; this machine secures the same effect with compressed air, and varies the speed of operation by means of a motor. Moreover, the machine has the advantage of never becoming tired.

A rubber bag filled with air takes the place of the hand. Pistons which force the air back and forth cause a rapid alternate contraction and expansion of the bag. The feet rest in supports over the bag, the holders having plates at the bottoms with enlarged central openings conforming generally to the shape of the members for which they are designed. If necessary, the width and depth of the plates can be reduced by the insertion of sectional parts. When the bag contracts and expands it comes into contact with the bottom of the sufferer's feet.



A foot-massaging machine that employs a bag alternately contracted and expanded with compressed air

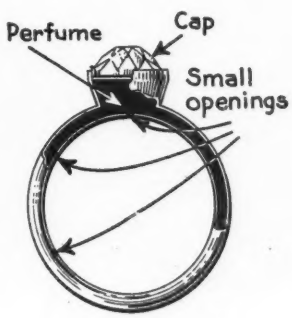
The massage bag is connected by pipes with two cylinders, fed from an air tank regulated by valves

---

Jewel Perfume Trickler in the Form of a Finger Ring

MODESTY has prevented us from mentioning the fact that now and then we have been vexed to find that the supply of perfume we had taken with us to our office would not last until the day's end. Imagine then our joy and rapture when we discovered that a United States patent had been granted to William H. H. Griffin, a citizen of Goree, Texas, for an invention which meets our case exactly.

Bill has perfected a hollow ring to be worn on the finger, into which the perfume is poured. The inner wall of the ring is provided with one or more apertures which are obstructed to some extent by contact with the finger, so that the oozing of the perfume will be slow and gradual.



This trickles your favorite perfume

The outward appearance of the ring is not different from that of any piece of jewelry worn on the finger, so that the source of the fragrant Aroma de Duck (our favorite) can not be detected. Bill says, "It may be sufficiently large to serve as a bracelet and for other purposes."

Let us suggest, Bill, that you carefully preserve the refinement and dignity of the Trickler. Won't you try to prevent some coarse 'longshoreman from making one large enough to go around his waist so that he may carry his soup in it?

Can an Airplane Jump Straight Up?

Recent progress in propellers

By Carl Dienstbach

IN July, 1905, I had occasion to visit the Wright Brothers in Dayton, Ohio, as the representative of a leading aeronautical journal. At that time the two brothers had finally reached a point where the road to success lay open before them. At first they were rather reticent, but gradually they thawed out and told me many interesting things. One of the subjects that unsealed their lips was the aerial propeller. They waxed warm in denouncing the whole mathematical theory of the marine propeller, which they had studied with great care. Five years later a learned marine architect attacked that same theory with great energy and asserted that propeller efficiency had formerly been altogether a matter of chance. The suction side of the blades was considered negligible and when it was deemed necessary to strengthen the blades by making them thicker, the additional thickness was put on the suction side, as it was believed it would diminish the efficiency of the propeller if placed on the other side. As a matter of fact, only the suction side really counted and the bulging surface given to it by blind chance was the very thing that made it efficient. A true helix would have been as inefficient as a flat plane.

Wilbur Wright said among other things: "We know now how to make a propeller. We can foretell its efficiency accurately. It must be in accordance with the theory of the airplane and must have curved surfaces. But, the best propeller for starting is not the best for flying."

He was right. To be efficient the blades must not strike the air at too steep nor too flat an angle. While the machine moves fast ahead the air resistance to the motion of the blades strikes the blades at an angle, the steepness of which diminishes with the speed of the forward motion, thus practically lowering the pitch of the propeller. At the moment of starting the blades meet but little head resistance and a high pitch, with its steep inclination of the surfaces does not grip the air sufficiently to give the desired pull, in spite of the fact that it consumes much power. On the other hand, the pitch that gives the strongest pull in starting makes the engine race during a rapid flight. An engine with its propeller mounted on the crank-shaft is not designed for maximum revolutions. When it races efficiency falls; the valves are not large enough, with the result that the mixture of air and fuel is drawn through like wire through a diamond die. In addition the blades encounter then so much air friction that their efficiency is lowered.

For a long time this waste of power was met by equipping airplanes with engines

Eustis and his propeller. The lower picture shows the propeller mounted on an arrowhead-type biplane

the power and speed of which was constantly increased. Progress in flying has been stupendous, but landing has grown correspondingly more difficult and now requires great skill. The difficulty was felt less, however, as the increasing reliability of the engines made it possible to make landings only in certain places which had been specially prepared for that purpose.

Commercializing the airplane demands first of all greater independence from these large starting and landing grounds which are difficult to procure and expensive to maintain. An airplane must be able to rise from a field sixty feet square.

This can easily be done by making the pitch of the propeller adjustable while in action. If propulsion is twice as strong in starting, the airplane will leave the ground with one-half the length of run. Again, landing on a restricted area is mostly a matter of stopping headway. Any device which adjusts pitch can easily be perfected so as to reverse the pitch when desired. A very low reversed pitch is sufficient to act as a powerful brake without jarring or upsetting the airplane.

There is one special use of the airplane where the ease of landing and starting on difficult ground becomes paramount—the airplane ambulance. Again, the necessity of running an airplane on the ground like an automobile, to get, for instance, from a garage in the city to a field large enough for starting flight, makes adjustable propeller pitch practically indispensable. Adjustable pitch is also of great advantage in climbing and in crossing "airholes." In extremely high altitudes the pitch must be increased to prevent the engines from racing.

The accompanying picture shows adjustable propellers recently constructed by W. I. Eustis and tried with success in actual flight. It still needs development toward reversibility and has yet to prove its durability under hard usage.

Photos © Int. Film Serv.

Making a smoke screen to hide troop movements "somewhere" in France

An officer holding in his hand a smoke cartridge emitting a cloud of smoke

Smoke Cloud to Screen the Movements of Troops

A HEAVY cloud of smoke suddenly made its appearance over the camp of the enemy, completely hiding him from the view of the opposing forces. The section back of this screen was marked by considerable activity. Big guns were being shifted here and there; troops were hastily moving to new positions; reinforcements were arriving by the thousands —and when small rifts appeared in the smoke cloud the enemy was revealed in a stronger position, ready for attack.

Thus is cloud-forming gas employed in warfare. The gas is contained in a tube, and, when released, makes a dense cloud that effectually screens all objects for several yards around. Even the observer in the airplane finds himself baffled when he tries to see what is taking place on the other side of this curtain.

Although the smoke cloud has been described particularly as a means of concealing from the enemy the movements of troops seeking new vantage points, it can also be used effectively in reconnoitering. It is possible for soldiers under cover of a cloud to approach within a short distance of the enemy and escape detection.

Turn Him Sideways or Feet Up—He Cannot Fall Out

THE new stretcher perfected by the American Red Cross in France is described as superior to any means for carrying the wounded yet brought into use. Draw a mental picture of a soldier found wounded in No Man's Land, his bed of rocks and earth being situated so that it is impossible for an ambulance to approach nearer than a mile. There are two reasons which deter the ambulance drivers from attempting to pilot the vehicle to the wounded man—the impassable condition of the ground and the danger of the ambulance drawing fire from the enemy.

So two stretcher bearers, carrying the newly-devised means for bringing the wounded to ambulances, make their perilous journey across the battlefield, accompanied by a surgeon. The surgeon finds that the wounded man's legs have been fractured by the fragments of a shell. The patient is placed on the stretcher, which has a frame across which wires are laced from side to side and end to end. Straps of canvas and leather are passed about his shoulders, waist, legs and feet, enabling the bearers to carry the patient without fear of his slipping to the ground or causing him discomfort. In this way he is carried to the ambulance and thence to the hospital, located at a safe distance from the continuous pandemonium of the front line trenches.

Photos © Int. Film Serv.

The employment of this American Red Cross stretcher insures comfort, making a "spill" practically impossible

Building a Home and Business Around a Natural Icebox

THE owner of a plot of ground in western Montana discovered on his property a well which emitted a constant current of cold air which in hottest summer was at about 35 degrees Fahrenheit, the temperature of scientifically regulated refrigerators. With a business eye to economizing in ice he decided to build a house in such a position that the well would be at the side of the kitchen in a built-in addition. In this addition he afterwards placed shelves and receptacles for storing perishable goods

His next step was to build a store near by, with an underground pipe connecting the well with a room in the basement of the store. Here he planned to keep perishable merchandise. The pipe led up into the store, also. It was provided with a damper so that it could be opened or shut in order to regulate the temperature of the room. In this way electric current for operating fans in hot weather was saved.

At the opening in the pipe the force of air current is sufficient to sweep a man's hat from his head. No satisfactory explanation of the current has been found. In winter the air is warmer than the outside atmosphere and prevents the stored articles from freezing.

It would be a good idea to explore this remarkable well and see if it does not lead to a large cave in the bowels of the earth.

Talking Gloves for the Deaf and Blind

The system of talking through gloves, as devised and used by Dr. William Terry, is explained and illustrated by a diagram

WHEN the war is over how many thousands of men will be deaf or blind-and-deaf? They must be kept in touch with the world about them. This can be done by a very simple means —the use of a touch alphabet system with a so-called "Talking Glove."

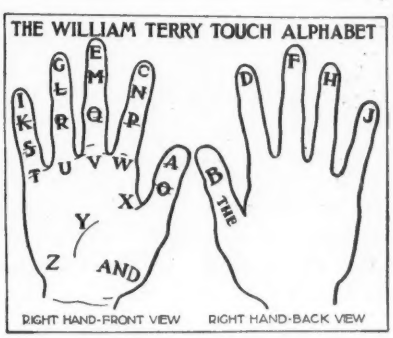
The basic principles of such a system are: (1) The arranging of the letters of the alphabet upon the hand in such an orderly manner that they may readily be memorized by the deaf or deaf-and-blind person. (2) The marking of these letters with indelible ink upon a white glove, so that any "speaker" even though unfamiliar with the glove can touch the marked letters, as he would the keys of a typewriter, and thus carry on a conversation.

Dr. William Terry getting the current news through talking gloves which he had devised

Dr. William Terry of Ansonia, Connecticut, has invented a system which is being widely adopted.

Dr. Terry lost his hearing as the result of the strain and exposure incident to his duties as a surgeon in the Civil War, but continued in the active practice of his profession for nearly forty years thereafter, until at the age of seventy he became totally blind also. At the age of eighty-two he wrote as follows:

"I found myself a dozen years ago in what the wonderful Miss Helen Keller calls the valley of two-fold solitude, totally deaf and blind. I could converse with no one and had to invent a system of touch alphabet for the hand, which by the use of a marked glove, has enabled me to enjoy the benefits of conversation. . . . By it I have been kept well informed on current events and in sympathy with the rapidly advanced and ever advancing philanthropy and Christianity of our blessed times."



The system devised and used by Dr. Wm. Terry for many years

No stronger evidence of the value of "Talking Gloves" could be found than the experience of two other deaf and blind men, each of whom worked out and used a touch alphabet for many years. Morrison Heady, of Louisville, Kentucky, used a talking glove while he was between the ages of forty and eighty-six years, frequently wearing it on the street, so that children could talk with him.

Henry G. Stephens, of Stratford, Connecticut, whose loss of sight and hearing was the result of three years of brave service in the Civil War, used a glove for thirty years. A knowledge of the Terry System is being spread among those in England, France, Belgium, Canada and the United States who are aiding men injured in the war, accounts having already been published in English and French and also in raised type.

Pamphlets describing the system will be sent free by Harold T. Clark, 1201 Leader News Building, Cleveland, Ohio, on request.

These beautiful terns somewhat resemble the gulls, but are smaller. Graceful and delicately colored as they are, such a flock as this presents a fine picture. Note the eggs laid in the sand

Royal Terns Caught by the Camera When They Were Not Looking

THE charming scene shown in the picture was taken on a small island near the entrance to Winyah Bay, Georgetown, S. C., and shows a large colony of royal terns at their breeding-place.

The royal tern inhabits the tropical and temperate parts of America. It is found principally along the coast, but occasionally also in the interior, as for instance, in Nevada and in the region of the Great Lakes. This unusually pretty bird breeds in large colonies along the Atlantic coast, from Texas to the Middle States. The females build no nests, but lay their eggs, from one to three in number, directly in the sand. The eggs are yellowish drab or creamy in color, sometimes almost white, and show irregular blotches ranging in color from dark umber to purplish. The terns resemble gulls in appearance and habits, but are smaller and more graceful, making quick dashes into the water when hunting for food.

Our Earth Has Had Many "Glacial Periods" or "Ice Ages"

ONE often hears of "the glacial period" or "the ice age" of the earth but, strictly speaking, this expression is not correct. It is now established beyond all reasonable doubt, that this planet has experienced not one but a great many glacial periods. Evidence has been found which proves that the latest or Pleistocene glacial epoch had several important subdivisions and that all of the present continents have experienced glacial epochs at different ages. Great ice sheets were formed at different periods back to the Proterozoic age, that is, the age of the oldest known sedimentary rocks, a great many million years ago. One of the most recent discoveries of old glacial deposits was made by Prof. W. W. Atwood, of the U. S. Geological Survey, near Ridgway, in southwestern Colorado. These deposits were found beneath tertiary lavas of the San Juan Mountains and resting upon Upper Cretaceous beds. They have, it is believed, been formed in early Eocene times.

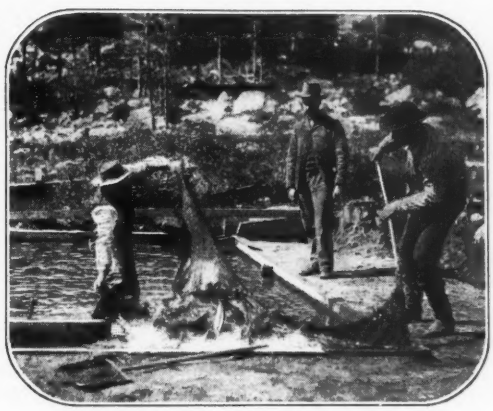
Raise Fish On Your Farm

The crappie and the sunfish become farm creatures like the horse, the hog and the cow

A fish pond on an up-to-date farm. Patriotic and thrifty farmers will raise fish to increase the food supply and incidentally share Mr. Hoover's burden

AN up-to-date farmer has a fish pond, just as he has a chicken yard or a pig pen. Fish can be grown and propagated in natural or artificial ponds, and the quantity of food they furnish should stimulate every farmer in America to have his own little fish preserve.

The chemical compound known as protein is an essential requirement of the human body. In the past we Americans have derived most of our protein from beef, mutton, and pork. But since the war has raised the price of all kinds of meat we must look to other sources for our supply of protein. Now—it has been proved that, pound for pound, fish contains as much protein as meat, and in some cases more.



No question about this big "catch" of fresh water "beauties"

Fish, adapted to culture on farms are the spiny-rayed or warm water variety. Ponds intended for fish may also furnish water for stock and its overflow utilized for irrigation purposes.

Several important points must be borne in mind by the prospective pisciculturist. There must be a constant supply of fresh water from springs or brooks and an outlet to drain off all surplus water. He must also make the bottom of the pond water-tight, so that a small inflow will be sufficient.

A layer of mud lining the bottom for the growth of aquatic plants, will grow food for the fish.

The fish best suited to pond culture are the different varieties of fresh-water bass, the crappie, the sunfish and the catfish.

The Acrobatic Air-Fighter

How the fighting Airplane is designed to meet the demands of the turning, twisting, tumbling air duellist

By Ottorino Pomilio

The illustrations accompanying this article are reproductions of paintings by Lieutenant H. Farré. The author of the article is one of the leading airplane designers of Italy.—Editor

FIGHTING in the air begins over the drafting board of the airplane designer and in the aerodynamic laboratory. Duelling with machine-guns at a height of 20,000 feet is the last phase of the struggle in which two "aces" engage. Unless the designer has produced the best possible type of machine, unless the laboratory tests have demonstrated that his creation is likely to be better than anything previously produced, an air duel may be lost.

What should be the characteristics of the fighting airplane? Of course, it should be fast, faster, if possible than the corresponding type of the enemy, and it should be a speedy climber. And yet swiftness and climbing ability are not its most important characteristics. Ease in executing the most audacious acrobatic feat is an accessory characteristic, it is true, and yet the machine that is not an acrobatic contrivance is worthless. Even armament, however powerful, loses enormously in effectiveness if the pilot cannot loop-the-loop, spin tail first, or slip sideways in safety.

An Air-Fight Graphically Described

A famous Italian "Ace," Major Principe Ruffo di Calabria, thus describes the tense moments of an attack and fight in the air:

"You approach the enemy machine from the rear with the speed of a meteor, at three or four hundred yards. Your forehead pressed against the front head-rest, your eye constantly at the telescope, you sight at the target and imprison the image of the enemy machine within the crosshairs of your telescope, a malignant insect caught in a net from which he cannot escape. You rise; you fall; you turn to the right, to the left; always you keep your telescope on the enemy. Not the hand, but the mind guides the machine. Although no straight line of flight is followed in your efforts to out-maneuver the enemy, you feel as if you were being dragged by an invisible wire—the line of sight. It all takes but an instant. Instinctively you press the trigger. Four or five shots and the faithful pellets have hit the target. They are tracer bullets; you can see the trail they leave. The enemy machine falls to the ground, perhaps aflame.

"Often you are counter-attacked. You escape; you attack again; you loop-the-loop, you hurl yourself about in spirals. All these maneuvers are always instinctive. Your mind alone guides the machine, obedient to the slightest touch of the controls. Thus your attention is not distracted. The control in your hand is like a light foil in the hands of a skillful swordsman. His will directs the point of his weapon, which flashes through the air exactly as if it were his projected thought. Woe to the pilot whose machine is sluggish in responding to the action of the controls!"

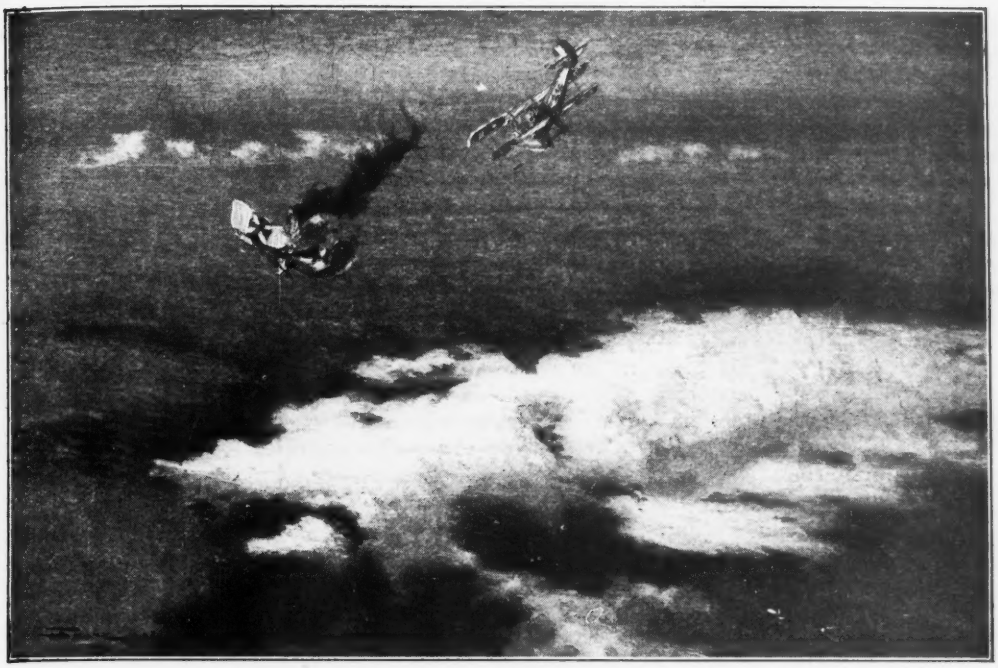
My object in quoting these words of a master of air-fighting is to fix the attention of the reader on the importance not only of speed, but of handiness, as an essential characteristic of a fighting machine.

The pilot of a fighting airplane must possess qualities akin to those of his machine. And they are? Extraordinary sensitiveness and that "finesse" of style, which in American slang is aptly termed "class." Such a remarkable pilot is not an acrobat by habit. To him an acrobatic trick is merely a tactical maneuver.

The problem of creating a new type of acrobatic machine is much more difficult to solve than appears at first sight. As a designer I cannot stop with an existing type. More powerful engines are being developed every day; new and more difficult exigencies of war constantly arise which must be considered in designing and building a new fighting machine. The designer must constantly outdo himself in order to keep the upper hand of an enemy who is naturally trying to outwit him.

Man's Limitations Must Be Considered

The designer encounters ever-increasing difficulties. He has to cope with a factor which may be considered as constant. That factor is man, his physical strength, his ability, his sensitiveness, all limited. Constantly confronted by the human factor, the engineer is taxed with the problem of designing a machine as docile and as easy to control as a less power-



"It all takes but an instant. Instinctively you press the trigger. Four or five shots and the faithful pellets have hit the target. . . . The enemy machine falls to the ground, perhaps aflame"

ful and therefore lighter airplane, and yet exceedingly fast and enormously strong.

Limitations are also imposed by speed. It is not difficult to make a machine fly at even two hundred miles an hour, but it is very difficult to land at high speed. A pilot cannot slow down to the same extent as a motor-car driver. There is a minimum beyond which he cannot go. This minimum, then, is a serious limitation which cannot be ignored. It is evident that nerves can transmit sensations so fast and no faster. We must be guided by what the best pilots tell us on that score. Landing at too high a velocity is dangerous, even on perfectly level ground. By too high a velocity is meant a speed of about seventy miles an hour. Although a field may be level, even a tuft of grass constitutes an inequality that makes itself felt when landing at high speed. Such slight inequalities form veritable obstacles, when the rolling speed of the wheels is high. A pebble will cause a racing automobile to leap into the air. And so it is with a flying-machine on a grassy field. Hardly perceptible indentations may result in disaster.

The Future May Bring Greater Speed

It is not impossible that in the near future, when specially constructed aviation fields will be numerous, when even acrobatic feats now performed only by the exceptional pilot will be performed by every flyer, the limits of minimum speed will be much higher than they are at present.

Besides the difficulties thus far considered, other conditions are imposed on the designer by the exigencies of war. The armament of a fighting airplane must be perfect. In fact, the machine must be considered as being nothing less than an animated weapon. Only then does the fighting machine become a terrible instrument.

The necessity of installing the guns so as to be readily accessible in a jam, and the desirability of locating the ammunition in a convenient place, offers the disadvantage that however we may try to minimize the head resistance by covering the guns with streamline hoods, the propeller shape of the fuselage essential to maximum air penetration is spoiled. To attain high speeds any irregularity of

shape, the slightest discontinuity in the surface of the fuselage means a loss in power. Evidently it must be left to the ingenuity of the constructor to reduce these losses to a minimum.

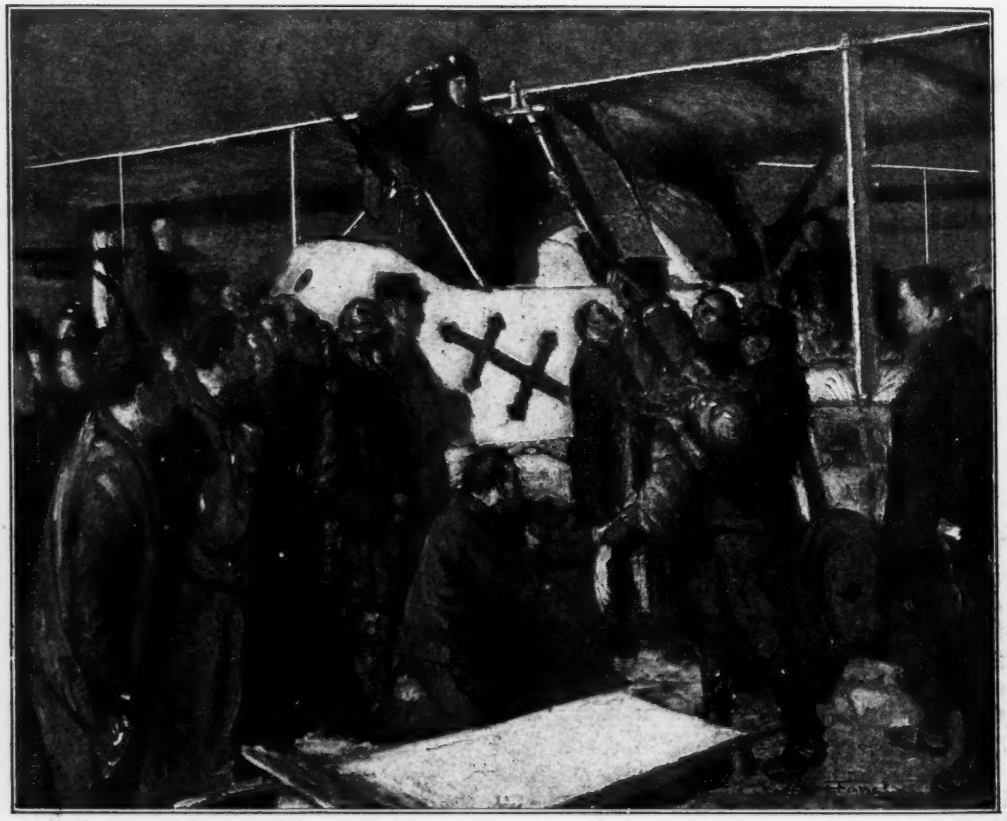
Other Obstacles to Speed

Another obstacle to increasing speed is the fact that the military pilot (and the fighting machine pilot especially) must have a wide angle of vision. The ideal shape for minimum head resistance is again spoiled, and more power is wasted.

This is not all. The fighting airplane must possess high climbing speed and must be able to reach altitudes greater than those attained by other types. To top his difficulties, the designer must produce a machine which will be enormously strong for its weight.

The strains to which a fighting machine is subjected while performing acrobatic feats or making quick turns at high speeds are enormous. Forces of considerable magnitude come into play in the rapid, violent movements required of a fighting airplane. The pilot himself can feel the increase in the normal stress in the whole machine as he twists and turns. These stresses, caused by a thousand rapid and violent changes in position and direction of the flying machine, are all controlled by the light and almost imperceptible pressure of the pilot's hands and feet on the controls.

In types of airplanes not used for fighting, more latitude is given to the designer. The good qualities of the machine may vary more. The lower limits are simply those tolerated by pilots. On the other hand, the fighting machine must always be perfect. If it lacks one of the characteristics previously pointed out the pilot cannot act effectively in an attack, which, in its most terrible moment, is a single masterly maneuver in which a dozen movements are inextricably merged, movements as subtle and swift as those of a cat.

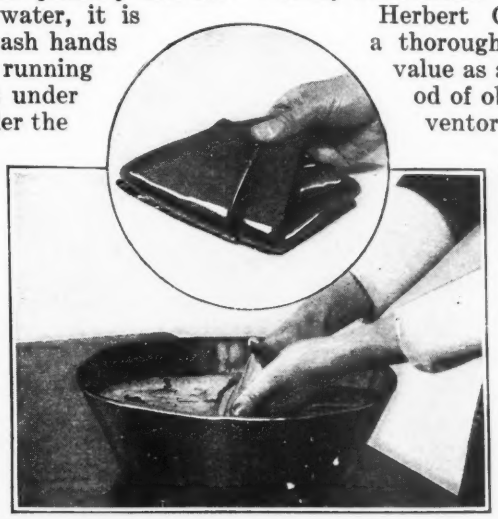


The Supreme Sacrifice

Don't Wash Under the Faucet. Carry a Washbasin with You

WHEN the plug in the hotel wash-basin is a minus quantity and the basin will not hold water, it is quite a struggle to wash hands and face from the running faucets, dipping first under the hot and then under the cold. It may be even worse—they may be spring faucets!

Welcome, then, the collapsible india-rubber wash-basin. It is of generous proportions when opened out, but can be folded into a compact parcel that can be slipped into one's valise. Or, if you are a mere man, you can carry it in your coat pocket. It is all right for a woman to transport it in her knitting bag as she goes about for business or for pleasure.

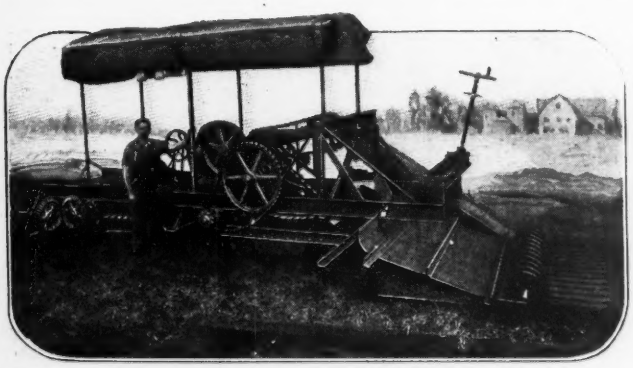


A wash-basin of rubber, which can be folded and carried in your coat pocket

Machine That Digs, Grinds and Blocks Peat

THE growing scarcity of coal has brought many heretofore neglected fuel substitutes, such as lignite and peat, into prominence recently. In parts of Europe peat is used extensively as a fuel; the peat bogs are considered a valuable asset. In America there are many localities where peat forms rich deposits, but heretofore little attention has been paid to it as a possible substitute for coal. This condition is likely soon to undergo a complete change and the beginning has already been made.

Herbert Garnett, who made a thorough study of peat, its value as a fuel and the method of obtaining it, is the inventor of an interesting machine, which is shown in the accompanying illustration. The machine, attended by one man only, travels over the surface of the peat bog, digs, grinds and lays out the raw peat in one continuous and uninterrupted operation. No hand labor is required until the dry fuel in small blocks is ready to be loaded into wagons for shipment to market. The complete drying of the peat requires from four to eight weeks. The machine is propelled and operated by a gas engine or an electric motor and is said to have a capacity of three to five tons of dry peat an hour at the cost of only one dollar a ton, according to the inventor.



This machine produces from your bog from three to five tons of peat an hour at a cost of one dollar a ton

Potato Butter to Reduce the Cost of Living

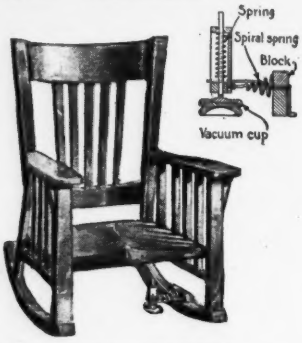
FOURTEEN ounces of mashed potatoes added to two ounces of butter will produce one pound of a very palatable butter-substitute. It can be colored to improve its appearance, and if kept for any length of time it should have added to it some butter preservative. A pound of potato-butter will cost only about ten cents. There are butter substitutes now sold that are wholesome and, when colored, can hardly be told from real butter. But this is the cheapest yet that we have any knowledge of.

Housekeeping Made Easy

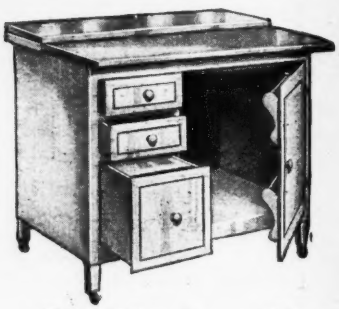
Mop wringer attached to the mop handle makes wringing easy and agreeable

This measuring spoon is made by halving a spoon longitudinally

Reading table for an invalid unable to hold a book



A vacuum cup prevents the chair from creeping



New design for a table cabinet made in metal and adorned with white enamel

Sandwiches can be arranged around the edge of this serving dish

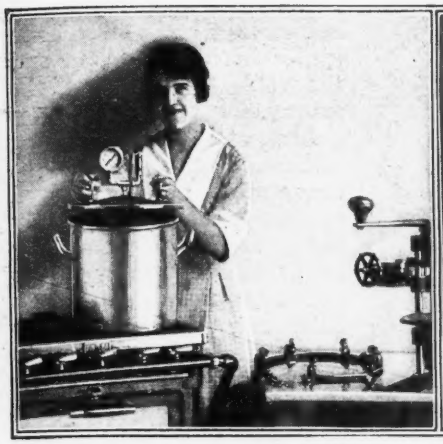
A laundry bag with a lock designed as a protection against theft

A rustic design for flower holders, made in cement

Dolls made of sponge make washing a joy and not a task for the little ones

Needles made for the comfort of the knitter in close quarters

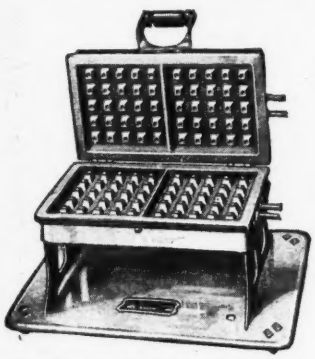
Housekeeping Made Easy



Small home canners are a help in preserving fruits and vegetables

A holder for boiling six "newly laids" at a time

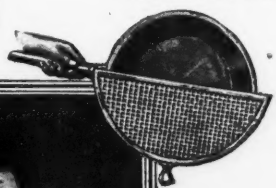
This waxing and floor polishing machine will prevent many a backache



Waffles can now be made on the breakfast table with this electric iron

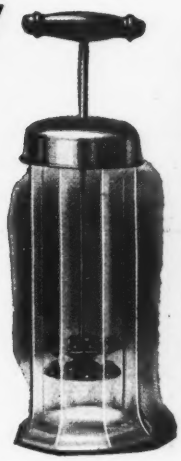
A fireless cooker and its numerous parts which are heated by electricity

Syrup cup holder that cuts syrup off without any spilling

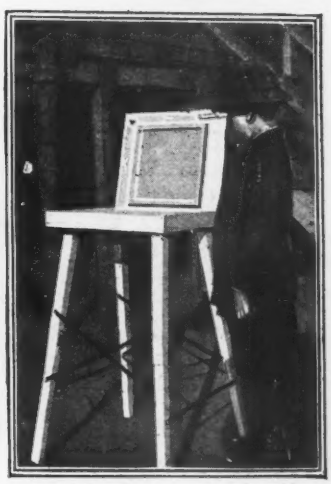


At the left is shown a strainer that fits on any pot or pan

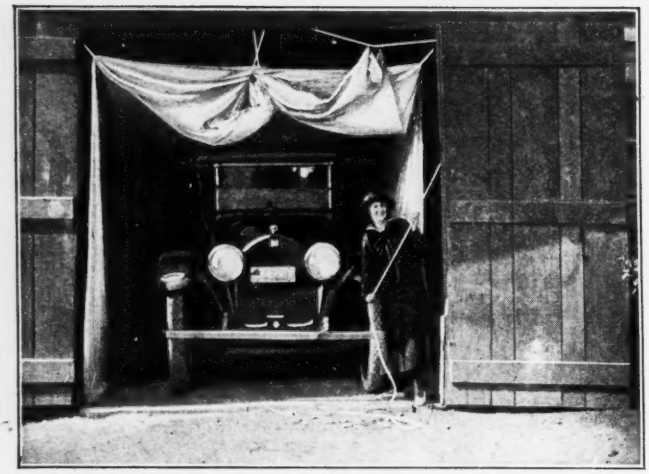
A neat and convenient holder to keep the twine ball ready for use



Small hand churn for "stretching" butter by working in milk



A folding stand for holding the wash basin in camp



The front of the tent is rolled up by a pulley system. When let down, the car is wholly protected against dust

Converting the Old Barn Into a Dust-Proof Garage with a Tent

HOW, by means of a tent, to convert an old barn into a very serviceable garage has been demonstrated by Herbert C. Goudge, a Los Angeles lawyer. When Mr. Goudge's horses were supplanted by gasoline, the stable had to house the car. Because the stable was anything but dust-proof, the car had to be cleaned very frequently. Mr. Goudge, therefore, conceived the idea of the tent shown in our illustration. This contrivance works admirably, keeps the car clean, and saves a lot of bother.

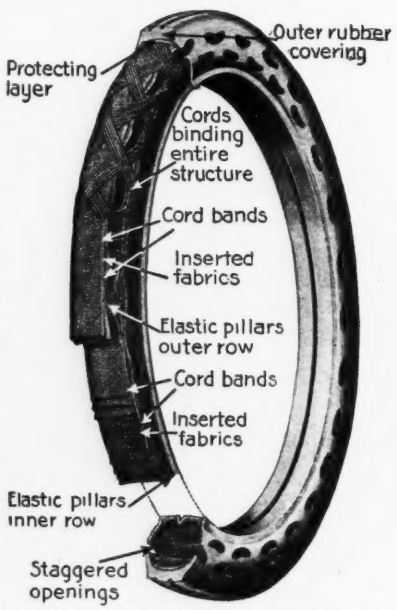
This Tire Is Built to Stand Strain

A TIRE that lays claim to many points of superiority over ordinary tires—whether pneumatic, solid, or of the so-called cushion variety—has been invented by three men of Roanoke, Virginia: F. A. Krusemark, L. G. Funkhouser and H. G. Carpenter. It is up-built of rubber, cord, and cord fabrics, and in its construction the principle of suspension is applied so as to utilize both the elastic and the resilient properties of the rubber.

Look at the accompanying illustration and you will see that elastic pillars rearranged around a base are tightly bound in place by encircling bands, and that around these bands are again arranged an outer row of elastic pillars staggered with relation to those of the inner series; these outer pillars are likewise secured by bands. Staggered openings penetrate the whole tire, and between the outer bands and their adjacent openings, as well as between the inner bands and their neighboring openings are inserted fabrics tending to increase the resistance of the bands.

The staggered openings increase the inner radiation surface to such an extent that heat is reduced.

The encircling bands—seven in the inner and six in the outer layer—have a combined tensile strength of 35,600 pounds, and a lateral strain, exerted by the car and its load, is evenly distributed throughout the tire by these bands. The interlaced cords, running spirally in series of five around the entire structure, have a tensile strength of 600 pounds each, or 3,000 pounds to a series; and since at least six of these series receive and distribute any lateral strain encountered, a total lateral resistance of 18,000 pounds is the support given by the body of the tire. The combined resistance of the encircling bands and the interlaced spiral cords takes care of the traction strain to which the car is subjected when the power is turned on the wheels.

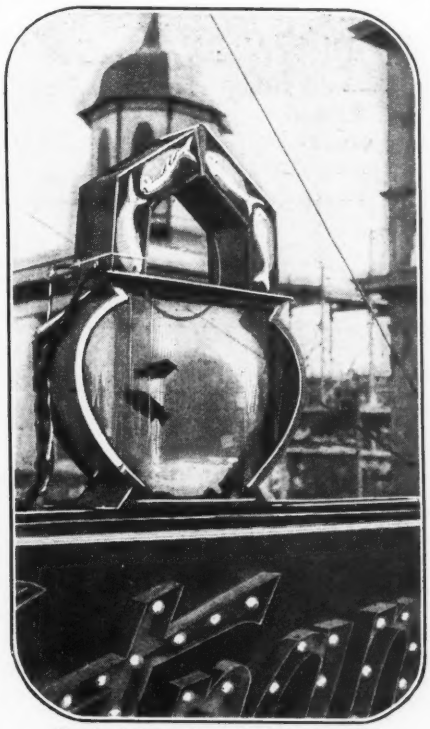


This tire is built to withstand strain better than the common tire

Live Fish Used to Advertise Fresh Fish Dinners

THERE is no limit to the enterprise of advertisers. The cafe owner of a beach resort in California showed originality in his advertising method, when he had the aquarium shown in the illustration placed above the cafe sign. In the aquarium, which has a glass front and back, two live sea bass are kept, which, by their lively movements in the clear water, attract more attention than any ordinary sign. The fish are supplied with fresh sea water and fed at regular intervals.

The water is conveyed to the aquarium by means of pipes. The live fish give the impression to the prospective diner that only fresh fish are served.

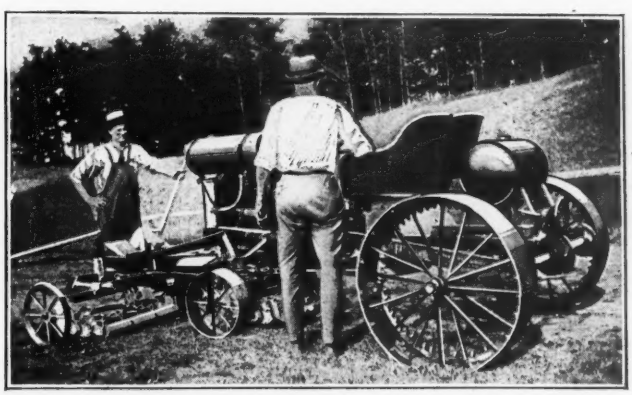


Cooked fish advertised by live fish in an aquarium above store sign

Making the Automobile Mow the Golf Course

BY combining an old horse-drawn lawn mower and a second-hand automobile an inventive member of a golf club in South Bend, Ind., produced a machine-power mower which has since proved highly effective in keeping the golf club's fairways in excellent condition.

The front wheels of the automobile were removed and the front part of the machine was so attached to the lawn mower as to rest upon its broad-tired wheels. Large tractor wheels were substituted for the rear wheels of the automobile.



This thoroughly efficient lawn mower with machine power was made by combining an old mower with an old automobile

Soldiers Use "Duck Boards" to Avoid Taking Mud Baths

WHEN the Allied forces in Flanders are not battling with the Germans, they are trying to outwit nature. This is the substance of a report brought back from the firing line by Major General Charles Clement, U. S. A.

Mud was a source of considerable annoyance to the soldiers. So the engineering force of Australia devised what has become commonly known as the "duck board," but which the Canadians have named the "bath mat," both being terms of derision.

The board is made of a number of small strips of wood, fourteen to fifteen inches in length, which are nailed to stringers placed in front of one another and extending for miles. A step off the "duck board" means a plunge into a sea of mud, at least three feet in depth.

The "board" was devised to enable the Australians to attack the Germans more successfully, and it served to provide a path to victory.

Making Boat Builders Out of Carpenters

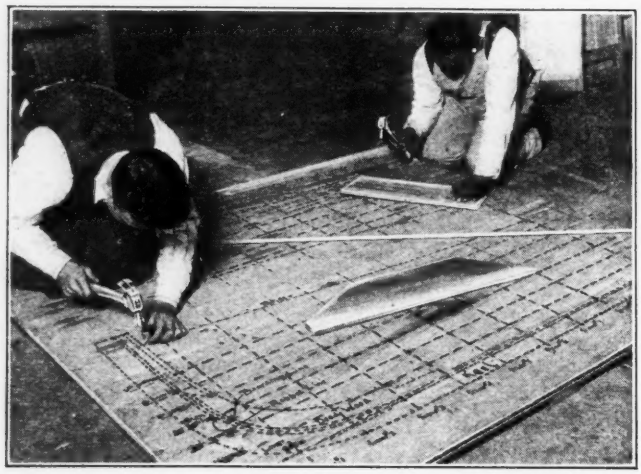
The failure of the old-time apprentice system leads the Pratt Institute to devise a new plan of training shipwrights

By Richard M. Van Gaasbeek

School of Science and Technology, Pratt Institute, Brooklyn, N. Y.

THE placing of huge orders by the Government and the erection of new plants have created an extraordinary demand for skilled labor, so much so that the United States Emergency Fleet Corporation is straining every effort to obtain an adequate supply of skilled men for ship and boat building. To assist the Government in meeting the labor situation a practical course designed to fit workmen for a line of work that is of vital importance to the nation at the present time has been inaugurated by Pratt Institute.

Such a course is all the more necessary because the old-time apprentice system has failed. The cost of trade training to the shipbuilding industry is almost prohibitive. A concern which pays not a penny for training attracts the trained apprentice by offering a little more than the standard wage.

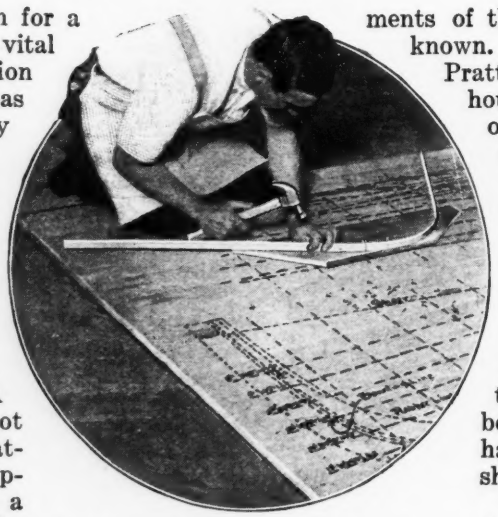


Men at work on the mould loft floor, picking up the lines of a vessel. This calls for a knowledge of descriptive geometry requiring much special study

Accordingly, an employer must, in self-defense, cut down the cost of training to a minimum. To do this, he must exploit the apprentice to such an extent that the cost of training is fully covered.

The war has brought the schools and the shipbuilders in closer touch. The possibilities of the schools are being demonstrated and their usefulness in this direction will increase as the requirements of the nation are made known.

Pratt Institute gives to house carpenters and other skilled wood-workers a practical understanding of wooden ship and boat building. The course is open only to experienced wood-workers in the trades mentioned and is intended for men just before or just after they had been transferred to ship or boat work.



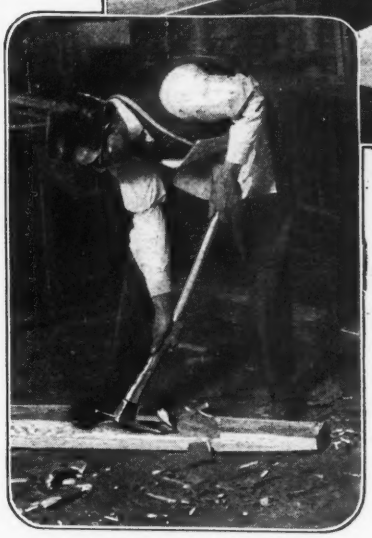
The bending of battens makes great demands upon the skill of the carpenter

Mr. Joseph F. Reardon, master boat-builder in the Brooklyn

Navy Yard, organized the class. When the demands on his time at the Navy Yard became so great that he was unable to continue as an active instructor Mr. Rassiga, Jr., Quarterman in the Brooklyn Navy Yard and Mr. Edward Weber, also connected with the yard, assumed charge of the class, carrying out many of the ideas suggested by Mr. Reardon.

A group of workers fairing up their moulds

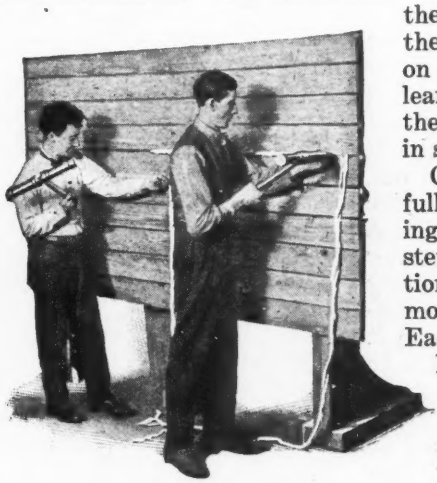
The outline of instruction given consists in such practical work as taking up moulds from mould loft floor, lining scantling from moulds, the construction of center frame, including stem, keel and stern, cutting rabbets, erecting transverse frames, scaling, beveling and installing planking, scarfing of planking and longitudinals, caulking (light and heavy work), installation of longitudinal clamps, deck framing, methods of laying decks, and plan reading.



Scarfing timber with an adze. It's not as easy as it looks

As a model a twenty-four foot powerboat was selected because it seemed to lend itself best to teach men how to build submarine chasers and smaller craft as well as larger ships. The fundamental principles involved in boat and ship work are very much alike. The lines are laid down on the mould loft floor, the lines are taken from the floor, the moulds are made, the bevels are developed and applied, the planking is beveled and installed in similar ways in both boat and ship work.

The illustrations give some idea of the work already accomplished by this class. Two pictures show men at work on a section of the mould loft floor. Laying down the lines of a vessel on the mould loft floor calls for a knowledge of the principles of descriptive geometry. It is not an easy task for the house carpenter to think in terms of boats or ships. He must have some idea of the construction and be familiar with plans before he can undertake the job of laying down the lines on the floor. The lines in these illustrations are laid down as a class problem under the guidance of the instructor. While they complete their parts they compare their work with the lines on the floor. Thus they learn to grasp many of the principles involved in ship and boat work.



Practising the art of caulking on a form soon makes a man efficient

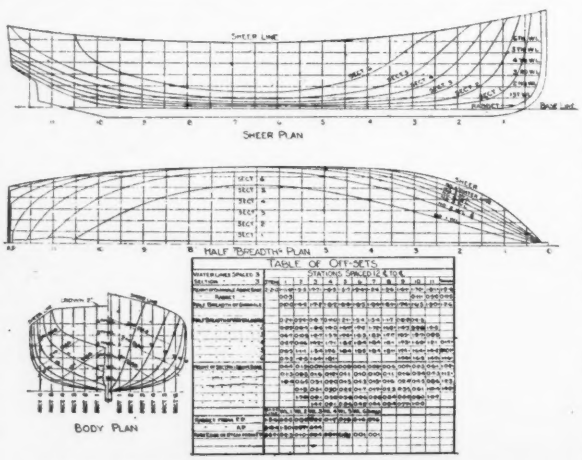
On the basis of carefully made working drawings the details of the stem and stern construction are laid down on the mould loft floor full size. Each man must pick up his lines from the floor, make his own moulds and get out all the various parts of the vessel from start to finish. This demands painstaking care.

Each man in turn is given individual lessons in caulking and an opportunity to practice on the form. This form is built of heavy stock and resembles the side of a ship. A lighter form is bolted on the face of this form from time to time, and instructions are given in both ship and boat caulking. Only a few principles underlie the art of caulking, and these can be taught by the instructor in a very few minutes, so that what the men actually need is an opportunity to practice and thus gain a little confidence in themselves before tackling the real job. A house carpenter hesitates to start in a new field of work. For the most part, the men are glad to practice on a form of this kind, with a few suggestions now and then from an expert, even at the cost of a few blisters on their hands. The heavy form is first caulked with cotton and then oakum. The lighter form is only caulked with cotton.

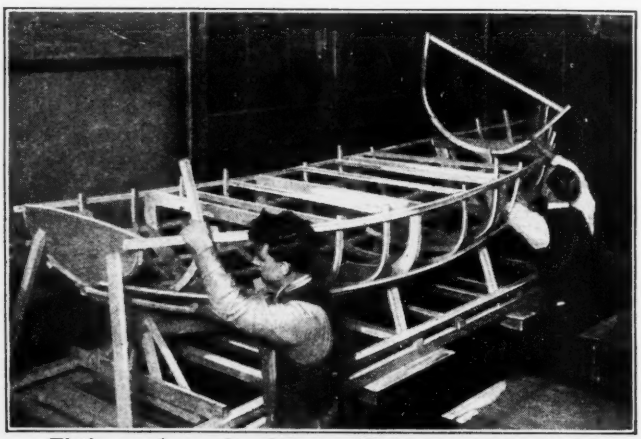
A group of men are shown scarping with an adze and splicing two yellow pine timbers together. The adze is a tool that a carpenter seldom uses and knows very little about. It takes considerable skill to handle it properly and to be able to cut to a given line. Some of the joints made by the men in this class would be a credit to men of longer experience.

Then are shown the offsets and developments of the moulded lines in the sheer, half-breadth and body plans. The men are shown how to apply these offsets, how to fair up their lines after locating points and how to develop their bevels from the diagonal lines shown on the body plan and how to apply these bevels on their frames.

In another picture the frames are being fastened in position. These frames are made of oak, steamed



Tracing showing moulded lines and offsets used in the shop during the construction of these boats

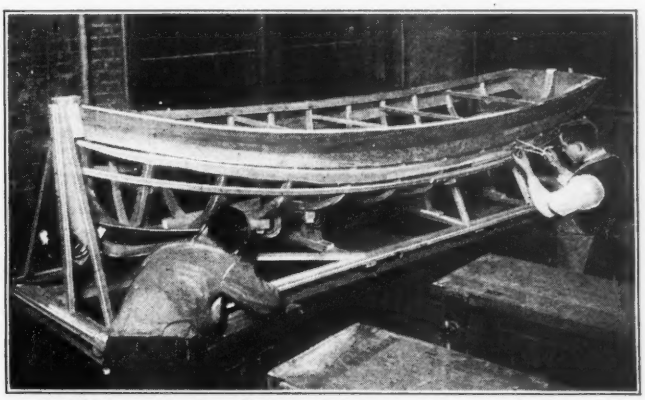


Fitting and erecting frames. They are steamed and bent on the form, then removed and shaped

Showing the installation of sheer or upper strake, a job requiring great accuracy as well as mechanical skill

and bent on a form in double thicknesses. After removing them from the form, they are re-sawed, paired (right and left), beveled, shaped and fastened in position. The ribbons are bent around false frames and faired up. These hold the lines of the boat until after the planking is installed, the ribbons being removed as the planking is fastened.

The upper or sheer strake and the second or binding strake are shown in position. The spiling batten is now being bent for the purpose of obtaining the shape of the next strake. It is necessary to get the proper shape of the planking before bending, so that when bent it will fit around the frame without springing or bending it.



Taking the spiling for the first lower strake and fastening down the garboard on the port side of the keel

Pratt Institute is trying to give to house carpenters and other woodworkers an experience that will give them the necessary confidence in their own ability, so that they will enter their new field of activities with some degree of assurance and not be afraid of the task set before them.

The following list of tools was compiled to give the men some idea of the tools used in the boat-building industry:

Claw hammer, crosscut saw, rip saw, panel saw, compass saw, ball pean hammer, adze, (lipped), spirit level, ship-carpenter's bevel, plumb bob, auger bits, one-quarter to one inch; extension bit, smoothing plane, jack plane, fore plane, bilge plane, compass plane, baller plane, wood reamers, one-half to one and a half inch; wood gouges, one-quarter inch to two inches; draw knife, caulking irons, caulking mallet, wood rasp, oil stone, cold chisel, cape chisel, spoke shave, ratchet brace, steel square, tri-square, seven and one-half inches; compass, hack saw, end-cutting pliers, marking gage, wood chisels, one-quarter inch to two inches; burr set, pinch bar, twenty inches; slice chisel, two- and one-half inches. There may be other tools needed occasionally.

Cutting rabbets, fitting and fastening parts of stem and stern

Two and Half Million—the Population of a Vacant City Lot

IN a little town in Illinois, Mr. George N. Wolcott conducted an investigation to find out how many animals—or, rather, forms of animal life—inhabited an acre of city land. The count in a city lot, obtained by multiplying the contents of a bucketful by the figures required for an acre, disclosed the fact that there were between two and a half millions of grasshoppers, locusts, crickets, cockroaches, earwigs, lantern-flies, plant-lice, aphids, and other "bugs" in one acre of land.

There will be of course a large variation in the count according to the season in which it is made. For example, there is a one third increase in the population in the spring over that in the autumn owing to the rapid multiplication of earthworms.

Safety platform for window-cleaners. It is securely clamped inside the window

Step Into the Guard Cage and Be Safe While Cleaning Windows

AMONG the more hazardous callings, that of the window-cleaner has received its share of attention from inventors of safety appliances of all kinds. The windows of a twenty-story office building are not cleaned without risk. Usually the cleaners wear belts which they hook to special fastenings; but not every building has the necessary fastenings.

John H. Cook, factory inspector for the Utah State Industrial Commission, is the inventor of an appliance that can be used on any building. His device consists of a collapsible platform which is clamped to the inside of the window and which supports a high guard-cage on the outside. The platform can be quickly attached and detached, and the whole apparatus weighs only fifty-eight pounds, which makes it easy to be carried up and down our skyscrapers.

This device throws light on dark places and exposes dental decay in time to obtain relief or frustrate its further progress

Thowing Light on the Dark Secrets of the Mouth

IT will no longer be necessary for a person who desires to count his teeth, or to see whether they need the attention of a dentist, to turn and twist himself before a mirror, with his mouth open till the hinges creak, trying to make the light strike so that he can get a view of his molars and bicuspids and other dental appurtenances. No, he can now put the light inside of his mouth, thanks to a new device which is compact enough to permit this.

This device, which should prove of service to dentists and physicians, is, in effect, an attachment to any electric-light socket, fitted with a voltage reducer so as to light a small opal bulb, to which is attached a small magnifying mirror, and which can be inserted into the mouth and held in place with an attachment to the cheek. Our picture shows it in use, and gives a clear idea of how effectively it illuminates the interior of the mouth and enables the operator to examine with minute care even the back molars or "wisdom-teeth."

That hollow tooth in the rear can now be examined with ease, and a plug of cotton saturated with oil of cloves inserted to insure a "sleepful" night.

This invention is not intended to rob the poor dentist of his livelihood. It simply enables the toothache sufferer to obtain temporary relief until it is convenient to undergo a dental operation with its incidental tortures.

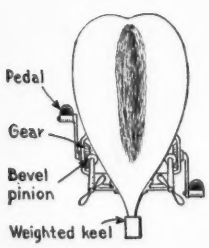
Creosoted Railroad Ties Give Double Service

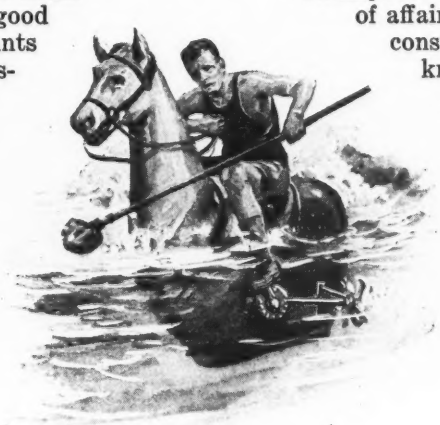
RAILROAD ties last about eight years under normal conditions, when they have to be renewed, which costs a good deal of money and calls for a large force of labor. It is estimated that treated ties which are first kiln-dried and then immersed in hot creosote until saturated last twice as long. They are absolutely water-proof and impervious to rot.

Why Not Water-Polo on Aquatic Polo Ponies?

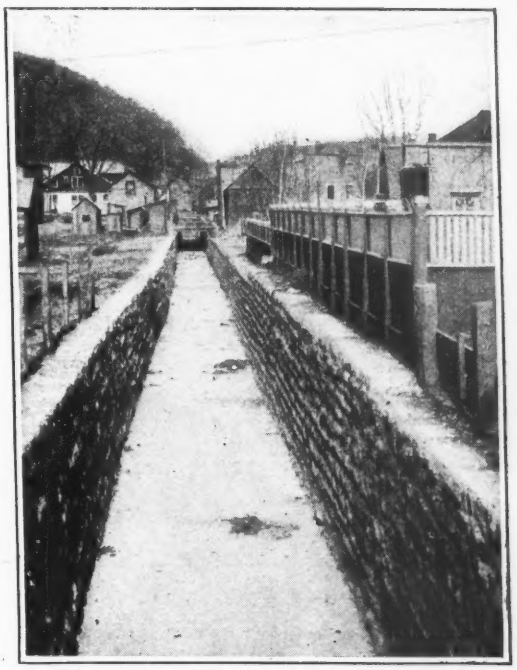
THE mechanically-propelled water horse recently invented by Antonio Alaj opens an interesting perspective in aquatic sports, which, heretofore, have been sadly lacking in variety. Some years ago a game was invented which, for some reason, was given the name of water-polo, although it had little in common with polo excepting the name. But now, thanks to Mr. Alaj's invention, there is no reason why there should not be real water-polo, played by riders mounted on water-polo ponies. For, after all, polo without ponies isn't polo at all.

The water-horse, shown in the accompanying illustration, is equipped with twin propellers which are rotated independently in either direction by a crank and gear arrangement operated by pedal. A good rider should be able to put his water-horse through the same paces through which good polo riders put their mounts and that would make possible fine sport, scarcely less exciting than land-polo and very much more novel as well as romantic.





The liveliness of the horse depends upon the strength of the rider's nether limbs

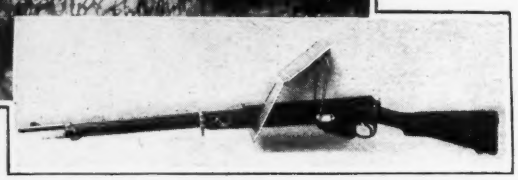


The hundred-thousand-dollar aqueduct which protects the town of McGregor against damage from periodical floods

Side-Tracking a Flood by Means of a Gully

THE little town of McGregor, situated in a pocket in the hills in Iowa, has had literally to entrench itself against invading floods. Because of its peculiar situation, every time there was a heavy rainstorm in the surrounding hills the unfortunate little town used to be swamped. To cope with this state of affairs the authorities have constructed what is locally known as the "Hundred-thousand-dollar Aqueduct"—a great rock and cement gully a mile long, which runs down the main street. Other branch water-courses are laid through the side streets, so that now any flood-water that comes down is side-tracked along the gullies and the town is safe.

American Army rifle with the bullet-proof shield in position and ready to shield the marksman



This side-view shows how the shield is adjusted on an ordinary American rifle

depend on the distance at which it was expected successfully to withstand rifle fire. Although it is probably too heavy to be carried by the individual soldier on long marches, provision is nevertheless made whereby it can readily be attached to the cartridge belt. The contrivance is believed to give full protection against rifle fire at five hundred and fifty to six hundred feet. If it is not too cumbersome for the soldier, already loaded down, there may be a chance for its adoption by the army.

Bullet-Proof Shield to Protect Riflemen in the Field

THE bullet-proof shield shown in the accompanying illustrations is the invention of Samuel J. Winn, Jr., of New York city. It is intended to give a fair degree of protection to riflemen firing from the trenches or in open territory, where natural covers are lacking. It may also be adapted for use with machine-guns.

The shield is made of an alloy of chrome and vanadium steel, with drop-forged rivets and other accessories. It consists of an upper and a lower part, which, when applied over the muzzle of the rifle, is shifted rearwards to a point near the lock and held there in an oblique position by the upper edge of the port resting on the lock's casing and supporting the shield. There is also a second port above the first on the lower half of the shield and in line with the sight of the rifle, so that the user will be shielded while aiming the rifle.

The total weight of the shield, with its lower part of a thickness of three and its upper part of four millimetres thickness, is seven and three-quarter pounds. The weight of the shield naturally would

Keeping Live Bait Alive on the Newly Devised Hook

FISHING without bait is a hopeless undertaking. Certain kinds of fish are so fastidious in their tastes that they can be tempted only by live bait. But, fishing with live bait, as practiced heretofore, besides being unnecessarily cruel to the bait, presented many difficulties. One of the greatest difficulties was to keep the bait alive. This difficulty is overcome by a device recently invented. A flexible clamp at the swivel is used to hold the bait by the mouth, while a pin passes through the holes in the clamp and through the lips of the bait, and is then bent downward and held in place by a keeper. A wire loop, also held by the keeper, may pass around the body of the bait as indicated in the illustration on the left.

How live bait is held to keep it alive

The clamp is useful also in keeping the bait's mouth closed during rapid movement through the water, preventing drowning, for even a fish or a frog can drown. Guards for the hook points are useful in preventing clogging by weeds. They also serve to balance the bait and keep it in a natural position.

It Works Like a Typewriter, and It Marks Linen with Precision

WHO is not familiar with the blurred illegible mess that very frequently results from the efforts of the laundry in marking linen? The fact that the ink is indelible does not add to the pleasure of the owner of the linen either. Now appears the power marking machine, made by a Cincinnati firm, which will do the work much more speedily, quite as permanently, and infinitely more neatly than any pen and ink, or a rubber stamp, ever used.

Instead of the usual smear on our linen, we shall now have it marked by this machine

JONES	W-349	GREEN	Z2485
BROWN	X117	BLACK	M6

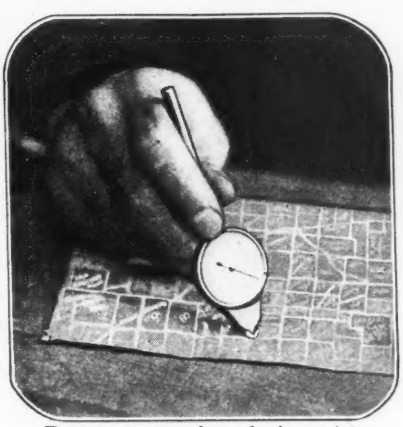
The machine itself is very compact. It is much like an adding machine in appearance, for it has a bank of keys for selecting the letters. The letters are composed by means of the keyboard, and the machine holds them firmly while they are linked by an automatic device. Then the mechanism presses the letters firmly against the article to be marked, which is held in a slot. The machine is operated by a one-tenth horse-power motor, and as it contains several alphabets and all the necessary signs and points, its scope is very wide. There is a guard on the machine to preclude the possibility of injury to the operator. The manufacturers of this machine assert that the saving over the hand method in time and reduced claims, frequently runs as high as forty percent. However that may be, it is certain to make our linen look better.

Run It Along the Map and Then Read Off the Inches on a Dial

FOR rapid work in scaling blueprints and other representations drawn to a scale, a new rotary measuring device has been invented which makes possible a direct reading in inches of the distance between any two points on the print or map regardless of direction, and it is especially useful for irregular lines such as streams.

The tracer wheel is placed at one end of the distance to be measured and is then rolled to the other end of the course; the dial then indicates the distance in inches. The actual distance between the two points represented can then be obtained from the scale of the drawing. An inner scale is graduated in inches to facilitate conversions from the English to the metric system, or vice versa, and also to make it possible to use the device on prints and maps with a metric scale.

The accompanying illustration shows how the tracer wheel is run over the blueprint and how the dial, actuated by the tracer, does the work of indicating the distance traversed, and does it with unerring mechanical precision. For the draughtsman, the chart-maker, the architect and the map-maker this device should prove to be a veritable boon. Much time will be saved and many mathematical calculations rendered needless by its use.



Rotary measuring device with dial that indicates distance between two points on the paper

Solving the Airplane Spruce Problem

How the I. W. W. is foiled; how wood-waste in building airplanes is now avoided and slow air-drying gives place to quick, efficient kiln-drying

By Frank Parker Stockbridge

THERE are six hundred separate pieces of wood in each military airplane. Ash, hickory, mahogany and other woods are used for the propellers, the body and some of the stiffer members of the wing-frames, but the airplane builder relies mainly upon spruce. Spruce forms the beams and braces that make the wings; spruce because it combines lightness, toughness, elasticity and strength. There are other light woods, such as white pine, but white pine does not readily spring back to its original form after being bent, as does spruce. Hickory is tougher and is elastic, but it is heavy; moreover, there is not enough hickory in the whole world to provide the timbers needed for the huge airplane fleet which is being built for the United States Government. So, of all the other woods that are available — none combines the qualities upon which the airman must depend for safety in flight as does spruce.

No Metal Is as Whip-like as Spruce

Even the lightest and most resilient of metal alloys, of which scores have been tried, crystallizes under the incessant vibration of 2,500 revolutions a minute, the engine speed necessary for flight at 150 miles an hour, which is not uncommon in modern warfare. No metal has the whip-like quality of resiliency which the essential members of the airplane frame must have to withstand the quick turns, the tail-spins, wing-spins, nose-dives, loops and other flying tricks, once exhibition "stunts" to be performed only by the most foolhardy, now every-day commonplaces in the aerial pursuit of the enemy. "Could the swiftest bird see and comprehend the things the modern airman does," says a famous American physicist lately returned from the front, "the bird would marvel even more than the untutored savage marvels at the bird."

It takes one hundred and sixty-seven board feet of clear, straight-grained, seasoned spruce to construct a single military airplane. Although this figure varies somewhat in different makes of types of machine, it is the average for military planes. But if a man walked into a lumber-yard and gave a casual order for one hundred and sixty-seven feet of this sort of lumber, the lumber dealer would laugh at the sheer impossibility of the thing. There has been no substantial amount of clear spruce in the Eastern lumber markets for years; in fact, old builders say they have not seen a single clear spruce board in twenty years. With the beginning of the European war France and Great Britain turned to America not only for airplanes but for the spruce lumber needed to build them in Europe. Spruce jumped to a premium, and up in the Northwest, around Puget Sound and in Alaska, timber-cruisers began hunting for the tallest, biggest, straightest specimens of the Sitka spruce, the tree that yields the finest quality of this lumber.

Speeding Up the Spruce Gatherers

Even before the United States entered the war, great difficulty was experienced in getting enough spruce for the airplane demands of the Allies. This was caused by labor troubles in the Northwest, where the I. W. W. almost completely tied up logging and lumbering operations for months, transportation difficulties, and the heavy wastage in getting out the long, straight pieces required for the longerons of the wing-frames. After the lumber was gotten out, it had to be seasoned. Even by the quickest processes in common use this required from three to six months, and there was great waste through checking and warping whenever efforts were made to speed up the drying process.

The total production of spruce lumber in the United States in 1916 was about

30,000,000 feet. When the plans of the Aircraft Production Board were finally approved by Congress and the United States entered upon its gigantic program of airplane construction it was estimated that a quantity as great as that would be required before the end of 1918 for our own airplane requirements alone. To speed up the production of spruce lumber, to cut down waste in manufacture and to devise some means of curing the lumber to the point of absolute perfection required in airplane work were the three big problems that the Government had to tackle. All three of them have been solved.

For speedier production there was organized the Spruce Production Division of the Army Signal Corps under the command of Colonel Price P. Disque, U.S.A. Two elements had to be combated—the activity of the I.W.W. and the actual shortage of skilled lumbermen in the regions where the best spruce is found. Colonel Disque decided to fight the I.W.W. with the L. L. L. L.—the Loyal Legion of Loggers and Lumbermen. The idea took hold quickly. It gave the men in the woods and the mills something tangible to tie to. Every one of its members, which now include a very large proportion of woodsmen, mill workers and lumber operators in the Northwest, subscribes to the following pledge:

"In consideration of my being made a member of the L. L. L. L. I do hereby solemnly pledge my efforts during this war to the United States of America and will support and defend this country against enemies, both foreign and domestic. I further agree, by these presents, faithfully to do my duty toward this country by directing my efforts every working day possible to the production of logs and lumber for the construction of army airplanes and ships to be used against our common enemies; that I will stamp out any sedition or acts of hostility against the United States Government which may come within my knowledge, and I will do every act and thing which will aid in carrying this war to a successful conclusion."

The logs are split by wedges driven in by a kind of pile driver device—a beetle

To supplement the working forces already in the forests, the Government went into the lumber country of Minnesota and began organizing "spruce regiments," enlisting loggers and lumber mill men for the Signal Corps, to go into the Northwest and get out the airplane lumber. Transportation difculties have been largely overcome by the establishment at Vancouver, Wash., on Puget Sound, of a Government Cut-up Shop, where finished parts for airplanes are shipped East, although a great deal of the lumber is still shipped to the factories in the rough.

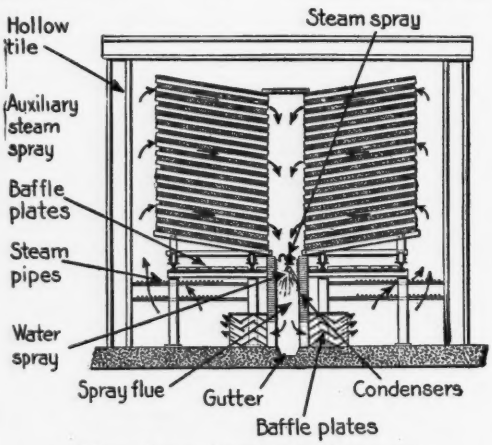
Cutting Down the Waste

Waste was a serious factor. By former methods of producing the lumber, it took about 1,000 feet of rough lumber to yield the one hundred and sixty-seven feet necessary for an airplane. This waste has been largely reduced, and before long it probably will take only 500 feet of lumber to each machine. One cause of the waste was the custom of sawing the logs into planks paralleling the heart or pith of the tree. The grain of wood runs parallel with the bark and not with the pith, so that when the strips for the longerons and other parts were split out of the planks there were always long

wedge-shaped pieces left, and many planks would not yield a single long, straight, clear piece with the grain running exactly parallel to the sides. To meet this difficulty, the system of getting out timbers by splitting or "riving" the logs into the beams or "cants" has been adopted. If the tree is straight-grained to begin with, rived cants are sure to be straight-grained, too. No explosives are permitted for splitting wood for airplane purposes, but all must be rived in the old-fashioned way, with wedges driven in by beetles.

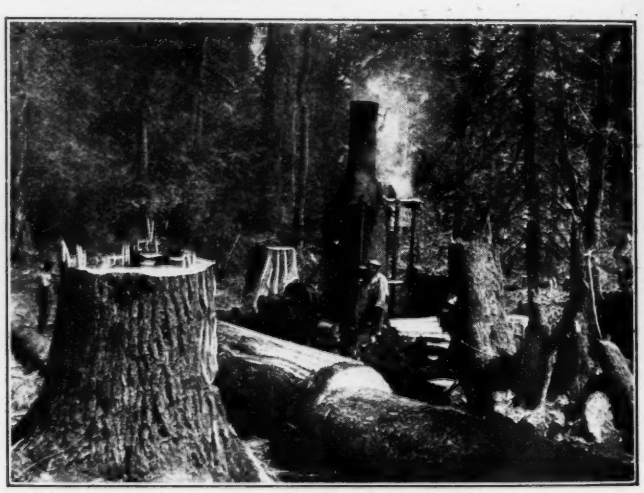
Signal Corps specifications for this lumber call for cants from 18 to 26 feet long, not more than 14 inches thick or more than 3 feet wide on the bark surface, with growth-rings not closer together than six to the inch. No piece may be less than seven inches in its smallest dimension or less than 50 square inches on its smaller end. Only the sap-wood is used, the hearts being entirely discarded. For this class of lumber the Government is paying bonuses for speedy production as high as $40 a thousand feet above the base price of $90 per thousand.

How to cure the green lumber, fresh from the forest, and make it equal to the best air-seasoned lumber that had formerly been the standard, but in a trifling fraction of the time required was the most vital problem of all. Thorough air-seasoning of such stock requires from one to three years. For a long time the Forest Products Laboratory of the United States Forest Service at Madison, Wis., had been making a scientific study of the drying of wood, and had developed some very successful methods. A large shipment of perfectly green Sitka spruce was sent to Madison, together with other woods used in airplane work. H. D. Tiemann, the Forest Service expert on the subject, was set to work on the problem, and by the adaptation of principles previously applied in the laboratory's experimental work, a system was evolved that is being used successfully to season the green spruce in fourteen days, or even a shorter time. Careful tests made by the Forest Service prove that this kiln-dried stock suffers less injury to its essential mechanical properties than does air-dried lumber, and the Forest Service specifications worked out from these experiments have been applied in dry-kilns con-



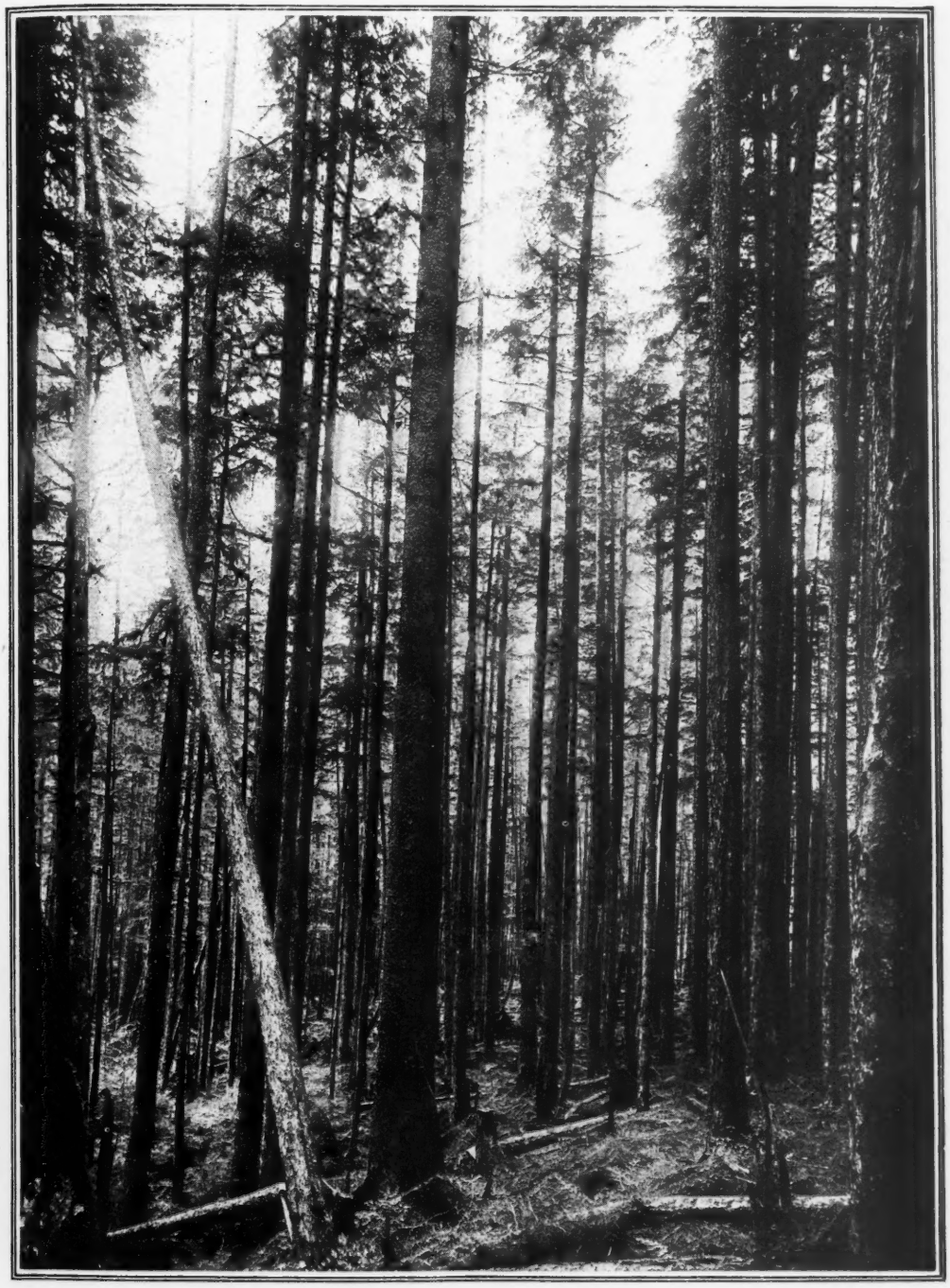
Here Green Lumber Is Seasoned

This diagram shows the arrangement of the dry-kiln devised by the Forest Service for seasoning green lumber in about two weeks. The kiln is so arranged that the amount of moisture in the air can be perefctly controlled. At first the air is kept moist to the point of saturation by injecting a fine spray of water into the flue through which the air passes. The heating of the drying chamber is effected by a system of steam pipes. For use at very high temperatures an auxiliary steam spray is provided. The condensed moisture runs into a gutter and is conducted back to the pump. The heated air rises above the heating pipes, circulates between the piles of lumber and, when it is cooled off, sinks down to pass again over the hot pipes, repeating its course



This is a typical scene in one of the Northwestern lumber camps whence practically all the spruce for making airplanes is obtained. The men have pledged themselves to stick

Soon They Will Be Airplanes



There was a time, not so many years ago, when spruce trees were common in this country. They are no longer plentiful. Reckless and wasteful deforesting has nearly eradicated this noble and useful timber. When the requirements of airplane building caused an urgent demand for spruce lumber, it became necessary to draw upon the resources of the Northwest. Around Puget Sound and in Alaska fine spruce forests may still be found and these supply practically all the spruce lumber which is used in building airplanes in this country under the direction of the Aircraft Production Board

structed under Government supervision, with the result that airplane lumber is now coming through in unheard of quantities and of a quality heretofore not generally obtainable.

A Saving Plan of Drying Airplane Spruce

The new kiln-drying method is based upon the fact that moist air with ample circulation is a more effective drying agent at moderate temperatures than is superheated steam or dry air at high temperatures. Since airplane lumber must be absolutely perfect, not only free from knots even as large as a lead pencil, but entirely without checks or cracks, the faults of ordinary kiln-dried lumber must be avoided. Too rapid evaporation dries the surface of the wood, causing case-hardening, as a result of which the more slowly-drying center of the plank shrinks away from the outside, causing "checks" or internal splitting. This also happens with air-drying at times. In the Tiemann kiln the lumber is heated clear through before drying begins and the humidity of the air is regulated so that the flow of the internal moisture to the surface of the wood is at the same rate as the surface evaporation, or even faster. At the beginning of the Tiemann process, in fact, the heated air of the kiln is humid to the point of saturation. After the lumber has been heated through, the humidity is gradually reduced, so that drying is from the center outwards. As will be seen from the accompanying diagram of the new kiln, temperature, humidity and circulation are always under control.

Some of the spruce logs, like those shown in this picture, attain a diameter of four or five feet, but most of them are thinner

Exit the Saw—Enter the Edge-Tool

When the rived spruce cants, kiln-dried by the new process, reach the finishing shops, every piece that is to be subjected to bending or twisting strains in the finished airplane is split from the plank or cant, instead of being sawed, and is smoothed and finished to shape so far as possible by sandpapering alone without the use of edge-tools.

So completely has the production of spruce and its conversion into airplanes been organized that it is now possible for an airplane to be on its way to France built of lumber that less than a month before was standing trees in the forest. What appeared at first to be insuperable difficulties have been overcome by the Government experts assigned to this special service.

Hypodermic Needles of Gold Instead of Platinum

THE war has upset many old standards and set up new ones. One of the curious results of this upheaval is that gold has been reduced, in some cases, to the rôle of a cheap substitute for other metals. Hypodermic needles, for instance, were formerly made of platinum or platinum-iridium, two metals now practically unobtainable. The increased war demand for these needles led to many experiments with other metals and alloys in the hope of finding a good substitute. A manufacturing concern, making a specialty of tempering precious metals, has recently perfected a hypodermic needle of specially tempered 14-carat gold, which offers many advantages. The metal has almost the hardness and rigidity of steel, is not attacked by steam, boiling water or chemical solutions used for sterilizing, and the needles are much cheaper than those of platinum or platinum-iridium.

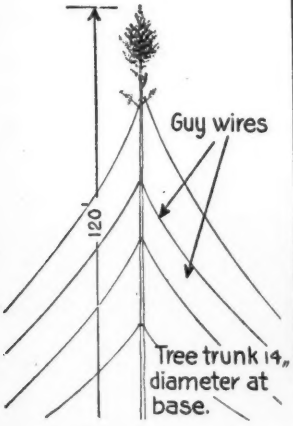
Here's a Dizzy Pruning Job

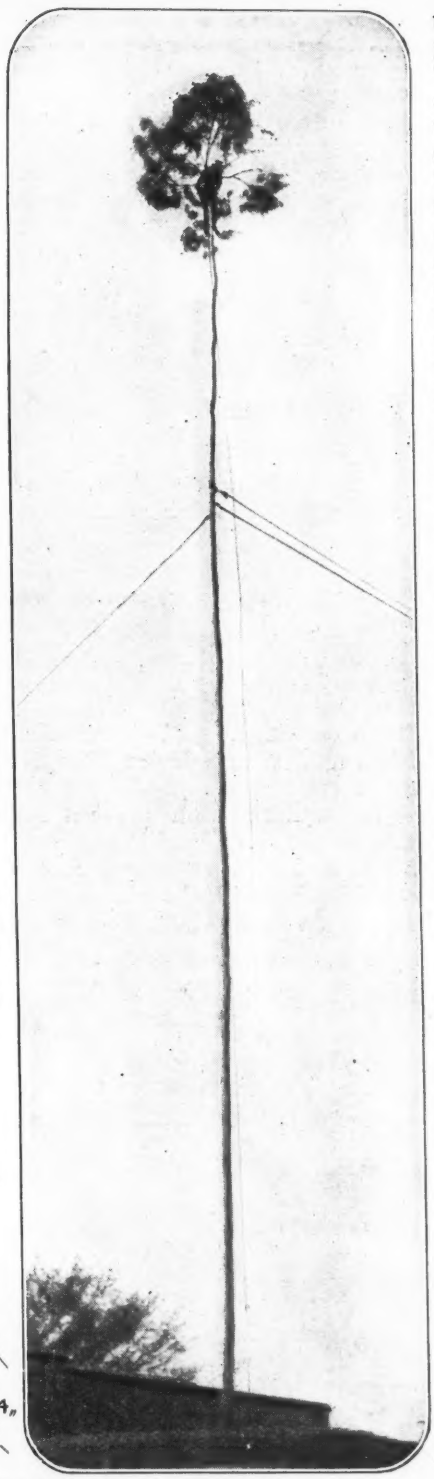
CLIMBING to the top of a eucalyptus tree one hundred and twenty feet high, and only fourteen inches in diameter at the base, in order to do a job of trimming, is the apparently impossible feat recently accomplished by Walter Seidell, a Los Angeles steeple jack.

The odd tree belongs to a firm of nurserymen, and has been cultivated as an advertisement. Recently the tree developed some scraggly looking branches along the length of the slender trunk. Could they be trimmed off? The steeple jack was consulted. He took the job without hesitation.

"It's easy," said Seidell.

Accordingly he strapped on a pair of linemen's pole climbers and wriggled up the first twenty feet of the trunk. Then he tied four wires to the trunk and dropped them to the ground. The wires were spread out at the base of the tree and were tied to stakes driven securely in the ground. Then the steeple jack climbed another twenty feet and dropped down another set of wires. In this way he ascended to the top. By that time five sets of wires were supporting the tree to keep it from breaking under his weight. The sprouts were trimmed off, and Seidell then climbed down, removing the wires as he came.





Trimming a twig 120 feet high and only 14 inches in diameter at the base. Note the man in the tree-top whose dizzy climb has called forth skill and courage

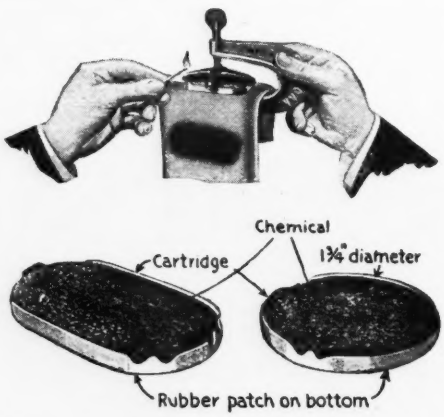
Great Sums to be Spent for Roads

THE present railroad situation in the United States has given a great impetus to the building of good roads throughout the country. The staggering total of $263,069,610 is the amount that will be expended on highways during the current year by the National Government and the different States. Texas heads the list with an appropriation of $25,000,000; Illinois and Indiana vie for second place with $17,000,000 each, while New York holds only tenth place with a ten-million-dollar appropriation.

Extensive use of automotive vehicles accounts for the demand for good roads and the enormous sums devoted to them during the current year.

Repairing Automobile Tire Tubes with Matches

TO repair a cut, tear or puncture in the inner tube of an automobile tire, use a match—but the right kind. And what's that? A new type of vulcanizer made in Wisconsin. No steam, electricity or fuel of any kind is needed to generate sufficient heat to cement together the damaged tire tube and the rubber patch, and there is no opportunity for burning fuel to drip off on your fingers and raise blisters.



A convenient contrivance for patching automobile tire tubes at little cost

The heat-generating medium is a neat metal cartridge containing an accurately - measured charge of non-flaming chemical with a patch of rubber attached to the outside of the cartridge. The cartridges are made in round sizes about two inches in diameter for punctures and in oblong units for cuts and tears. The rubber patches are applied to the damaged part of the tube by means of a small clamp, and the cartridge lighted with a match. This ignites the chemical which securely cements the patch in place, after which the cartridge is removed and the job is finished.

Autoists who have had sad experience with punctured tires will not be slow to try this new remedy, which should not be very expensive. Certainly it is not very difficult of application.

Work a Lever—That's All the Stevedore Has to Do

MUCH ingenuity has been expended on vehicles used in loading and unloading freight on wharves or at railroad stations. First came the two-wheeled hand truck, followed by the hand-elevating truck, which was a big improvement.

Then came the efficient electric industrial truck, capable of carrying up to two tons and of moving at three or four times the speed of a man. And now appears the elevating or self-loading electrical industrial truck, the most efficient inside mover of freight because, with it, manual labor is reduced to a minimum.

This remarkable labor- and time-saving device differs from other industrial trucks only in the platform which is mounted on pivoted levers, one at each corner, and in the platform raising means. The elevating mechanism consists of a small electric motor which drives a multi-thread screw through a worm gearing to tilt the pivoted levers to a vertical position. Thus the platform is raised. It is dropped to its low position by its own weight.

Running the truck's lowered platform, mounted on pivoted levers, under the load

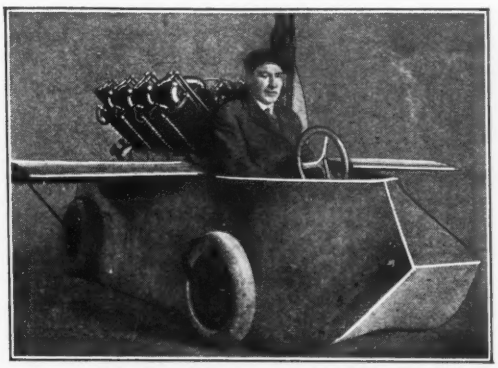
The platform, raised by an elevating mechanism, lifts the load and its support

Combining the Eagle With the Goose

A machine which is intended to fly like an airplane, to skim the water like a motor boat, and to run on land like an automobile

By Carl Dienstbach

AN airplane must be in motion before it can fly. It must make a preliminary run on the ground or water before it can vault into the air. Here we have a serious limitation in the use of the machine. Not every city has a large park from which the machine can start, nor a nearby waterfront.



The machine invented by Alexander Tesch, combining the motor boat, airplane and automobile

In order to give the flying machine the attributes of a boat and an automobile, so that it can be driven under its own power either to a waterfront or to a suitable starting ground on dry land, inventors have devised some startling combinations. Some of these have already been preserved for posterity in the pages of the POPULAR SCIENCE MONTHLY. The latest to which our attention is drawn is the conception of Alexander O. Tesch.

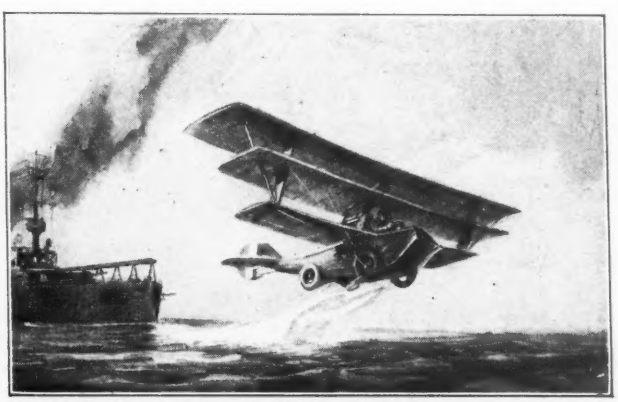
The provision of a suitable boat body is easy enough. But who shall be the first to provide wings that can be folded back out of the way so that the machine can travel along an ordinary roadway without occupying more space than an automobile? We are not informed of Mr. Tesch's solution of this phase of the problem.

Nor has Mr. Tesch told us anything about the very necessary tail of his machine and how it is to be disposed; nor of his propeller, which must be prevented from guillotining pedestrians.

The engine is said to be of one hundred and eighty horsepower, which seems to be sufficient to drive the machine up hills.

The machine as it is pictured in the photograph, is a monoplane. But a triplane must be the inventor's ultimate plan. A three-decked machine would not be nearly so high as an ordinary motor truck and might even be permitted to run along the street. Moreover, triplane wings could be made to fold back around vertical pivots in the center. A triplane would be sturdy enough to endure the shaking which would result from running over poorly paved streets without danger of loosening stay wires or wing coverings.

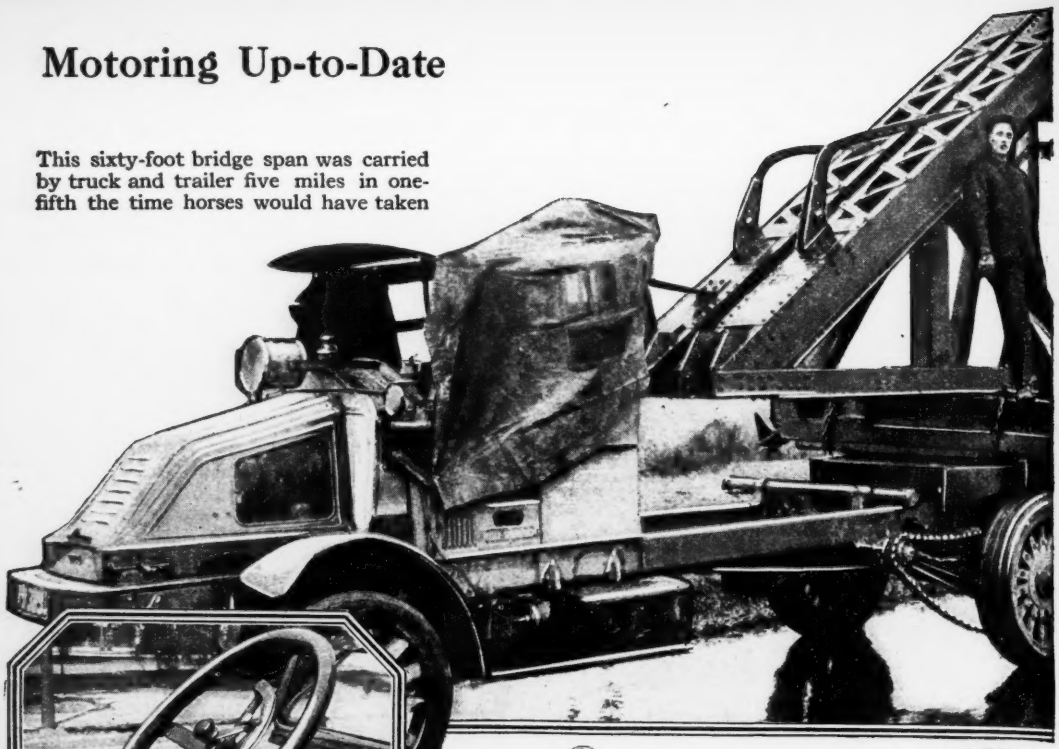
It must be admitted that machines and engines have become so sturdy that the whole scheme of using an airplane as an automobile is far more feasible than it was five years ago and new improvements and startling developments may be looked for any day.

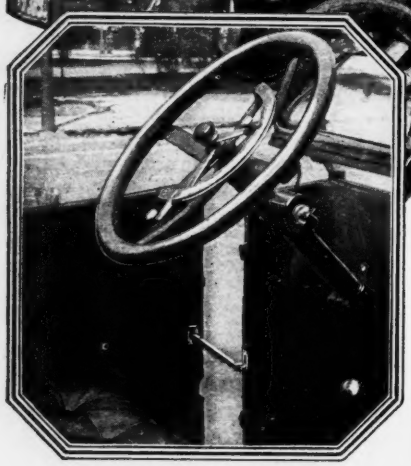


If developed along the lines suggested in this article, the machine, in flight, would probably look like this

Motoring Up-to-Date

This sixty-foot bridge span was carried by truck and trailer five miles in one-fifth the time horses would have taken

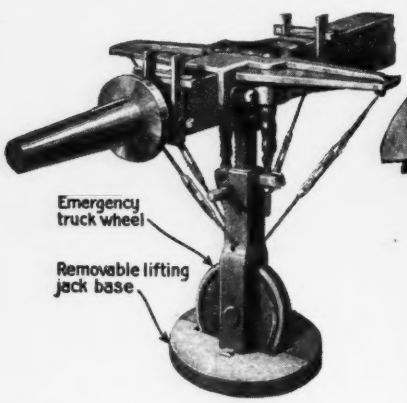




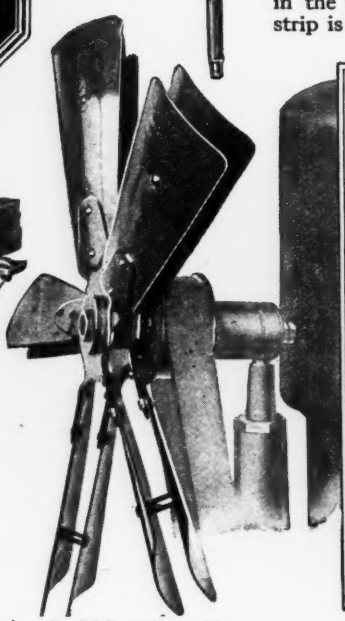
A hook to hold the front door of a car open in summer

A combination tool consisting of a tire gage, compression gage and magnet tester is shown at the left

To make lighting of the oil lamp at the right easy in the wind a sandpaper strip is fixed on the inside

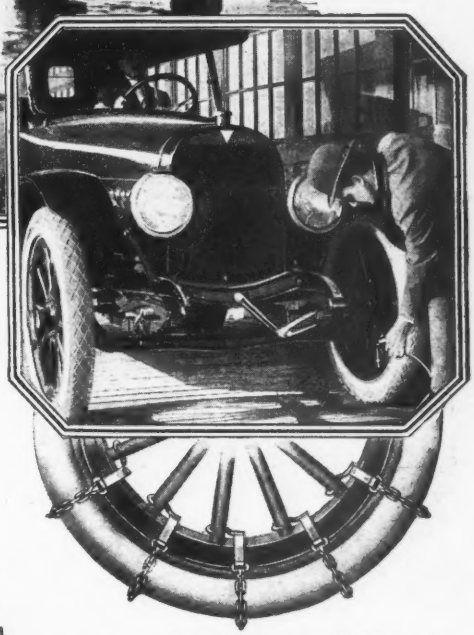


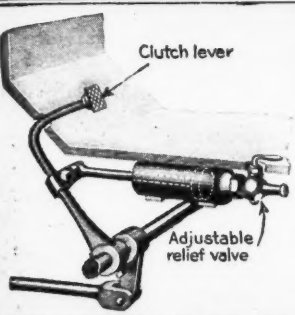
Combined jack and wheel for raising an axle and towing in a disabled car



A dual-bladed radiator fan for automobiles that gives increased air

A combination lock for closed car doors. This lock saves hunting for the key

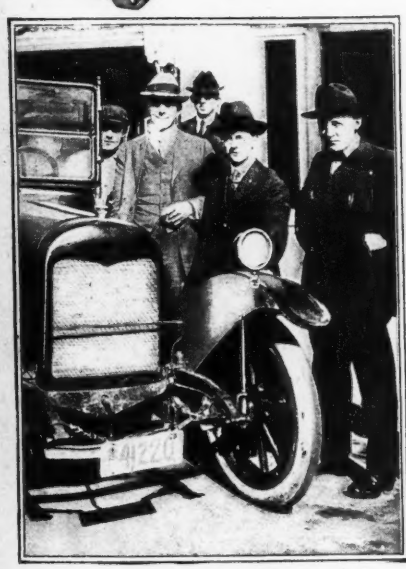




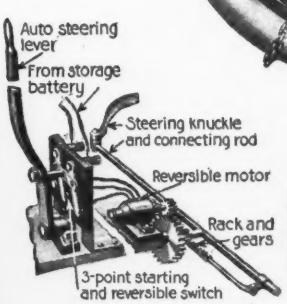
The crank-holder at the right is a piece of inner tube lashed to the spring

At the left is a compression pump attached to a clutch lever to make its engagement smooth

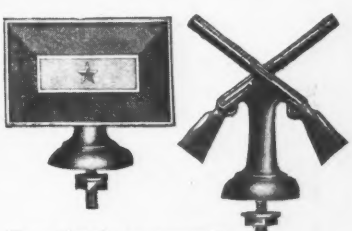
Individual anti-skid tire chains. One chain to a spoke



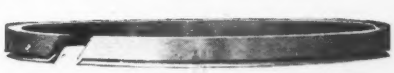
A lamp made dirigible by being connected with steering knuckle pin



A motor driven steering device operated by a lever on which a reversing switch is attached



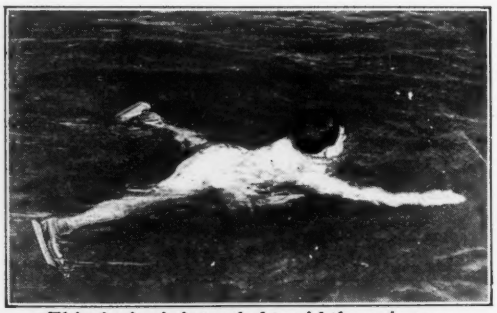
Two timely ornaments for the radiator cap



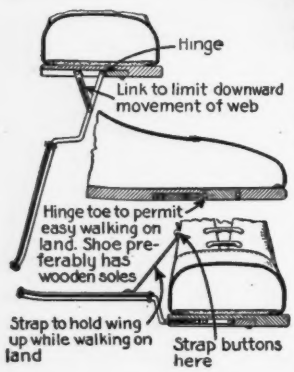
A groove cut in a piston ring to prevent oil getting into the cylinder

Put On These Webbed Sandals and Swim Like a Duck

WHEN you have tried to swim fast, haven't you wished you had webbed feet like a duck? Conrad Schneider of New York must have wished so, too; for he has invented a "swimming sandal"—an attachable web for one side of your foot. To use his invention you must wear a pair of special wooden soled shoes.



This device is intended to aid the swimmer. A swimmer wearing webbed sandals finds swimming easy—as the common duck does


Hinge
Link to limit downward movement of web
Hinge toe to permit easy walking on land. Shoe preferably has wooden soles
Strap to hold wing up while walking on land
Strap buttons here

Hinged to the bottom of each sole by means of metal plates are two steel levers, one at the heel and the other in the center of the sole. Each pair of levers supports at its outer ends a frame as large as a shingle to which is fastened the web, which may be good cloth or other similar material.

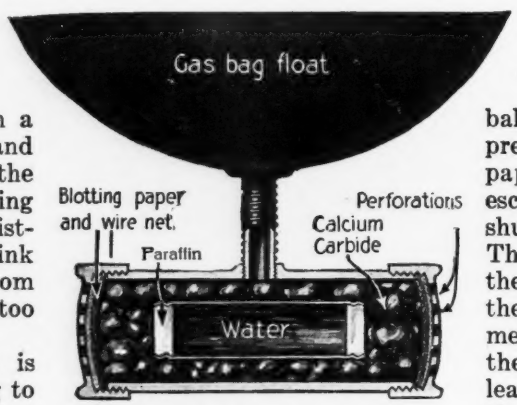
Thrust your foot downward or backward, and the web projects to one side and acts as an extension thereto, thus increasing its effective area in pushing against the water. Draw the foot upward and the web collapses in a downward direction and trails along after the sole of the shoe, offering practically no resistance. A small link prevents the web from moving downward too far.

This contrivance is no doubt interesting to experiment with, but is hardly practicable.

Throw the Life-Preserver Overboard and It Inflates Itself Automatically

"MAN overboard," shouts the lookout. Instantly there is great excitement among the crew and passengers on deck, who scurry around for something to keep the drowning man afloat. When nothing can be found suitable for the emergency and the rapidly tiring youth is about to sink for the last time, a passenger suddenly throws him something that looks like a knitting bag. It sinks on reaching the water, but soon rises, transformed into a balloon, the handle of which the drowning man grasps and keeps himself afloat until a boat comes to rescue him.

This device consists of a rubber balloon encased in stout canvas and connected by a strong tube with a metal cylinder, which serves as a handle and holds the chemicals for inflating the balloon. This cylinder, closed at each end by a perforated metal cover, backed by several layers of blotting paper and wire netting, is filled with calcium carbide in which is embedded a small tube holding water, closed at both ends by stoppers of paraffin. When the device is submerged, water penetrates through the perforations and soaks through the blotting papers, communicating moisture to the carbide. Acetylene gas is at once generated, which inflates the balloon, and by compressing the blotting paper, prevents the escape of the gas and shuts out the water. The heat generated by the decomposition of the carbide, however, melts the stoppers of the tube and the released water keeps up the supply of acetylene gas for the balloon.

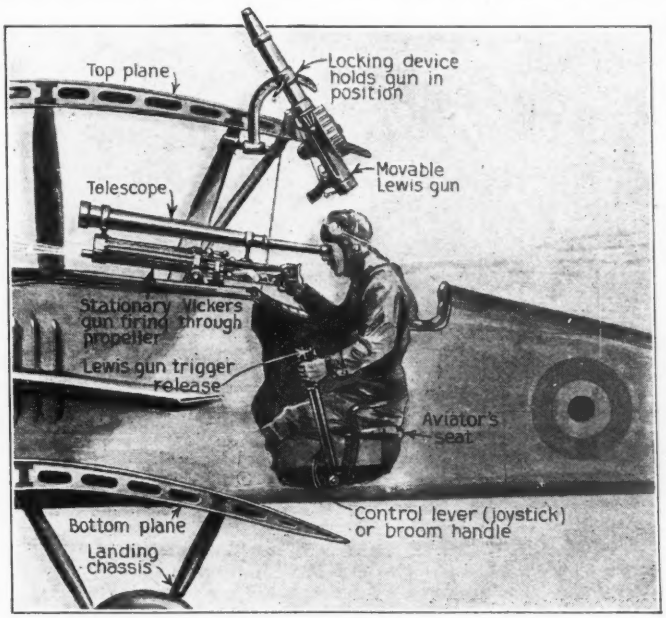


This life-saver with ingenious mechanism is good for emergencies

Firing Two Guns at Once

An ingenious method of firing both overhead and straight ahead in British fighting airplanes

As readers of the POPULAR SCIENCE MONTHLY know, the machine-gun of a fighting airplane is fixed in position. It fires through the propeller, the gun and the propeller being so synchronized that the bullets will not hit the blades. In some Nieuport airplanes as many as five machine-guns can be fired simultaneously, three of the guns being mounted on the top plane, and two in the usual position to fire through the propeller. All of these five guns are Vickers-Maxims and fire straight ahead. The entire machine must be turned to aim them.



It is a busy time for the aviator when he has to fire at one enemy in front and another above him at the same time

It is conceivable that a situation might arise when the pilot of the fighting plane must be prepared to meet not only an adversary who is swooping down on him from overhead but also another adversary in front of him. In such a situation his fixed machine-guns will aid him little, especially against the man above him. In one of the latest British one-man fighting machines, therefore, two machine-guns are so arranged that the pilot fires both of them at once and yet one of them enables him to fire overhead. One of the machine-guns is a Vickers-Maxim which is fixed and which fires through the propeller in the usual way; the other is a Lewis which is attached to the upper plane and which is fired from the control lever or "joy stick," as it is called. The Lewis gun has a locking device operated from the butt by pushing a button, so that the gun can be locked in any position on its swivel.

Suppose the pilot is attacked by two enemy planes. He has only to lock the Lewis so that it fires straight overhead and to turn his plane toward one of the oncoming foes. With his right hand on the Vickers' trigger, he can open fire as soon as the range is ripe. His left hand is on the control lever with which he governs his airplane and also fires his Lewis. The Vickers starts its sharp crackle as he gets a bead on his enemy. Above him appears another enemy machine. A quick glance upwards, then a sharp pressure with the thumb of the left hand on the gun trigger release attached to the control lever. Rat-tat-tat-tat! and the man who has been hovering over him like a hawk receives a stream of bullets.

Throughout the entire fight, the pilot is able to keep his left hand on the airplane control lever. When he changes drums on the Lewis, he uses his right hand. These cartridge drums are so made that they can be renewed without any difficulty in a few seconds.

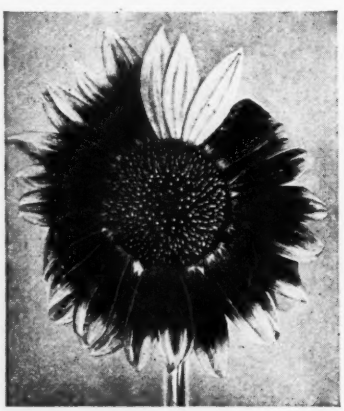
Why Should a Red Sunflower Have Some Yellow Rays?

THE sunflowers of which we publish photographs are remarkable because in one of them three rays (a sunflower's "petals" are called rays) are yellow and the rest a deep chestnut red, and because in the other, the rays are about half yellow and half red. Normally these sunflowers are solid chestnut red. Some change must have taken place in the cells of the flower, with the result that the colors were intermixed. What is the explanation?

Science tells us that after fertilization takes place the characters of the resulting individual are fully determined. The egg determines what shall be the nature of the chicken ultimately hatched. Of course, these characters may be constantly modified by environment. However, we are beginning to doubt this, for there are many exceptions, especially in birds, insects and mice. As a general rule, changes are supposed to occur only in germ-cells and not in body cells. But the sunflower offers an exception. Do the yellow rays represent a germ or body change? To this question the scientists can not give a definite answer, although they say that the change can be more easily explained by supposing that the body cell was influenced in some way. If the change took place in the germ cell, each yellow ray must have been derived from two different types of cells, the yellow predominating over the red. On the other hand, if the change took place in the body cell, one of the known color determiners of the flower, in this case the red, became lost, and there was nothing for the rays to do but grow on yellow cells alone.

How Did It Happen?

The sunflowers in the accompanying illustrations present an interesting problem. Plant biologists have advanced various theories to explain the freakish coloring, but the question is by no means definitely settled. The original photographs were kindly supplied by the American Genetic Association



We Know Some Human Beings Like These Caterpillars

THE Pine Processionary caterpillar has a strange habit of taking long hikes in search of food. These expeditions are always conducted in a long procession, the caterpillars marching single file, the head of each caterpillar just touching the tail of the one in front. The leader alone has the right to wander where he pleases. The others, guided by an age-long instinct, follow unquestioningly.

The thought occurred to J. H. Fabre, What would happen if the caterpillars could be induced to walk in a circle so that there would be no leader? He satisfied his curiosity by studying a procession of caterpillars which were marching around the rim of a large vase in his greenhouse. He carefully removed the caterpillars which were not necessary to form the complete ring and proceeded to watch the result.

For seven whole days, except at nights, the caterpillars continued the march along that fifty-three-inch circle. They became emaciated and so fatigued that they could scarcely move. Yet the only rest which they had during the whole period was at night.

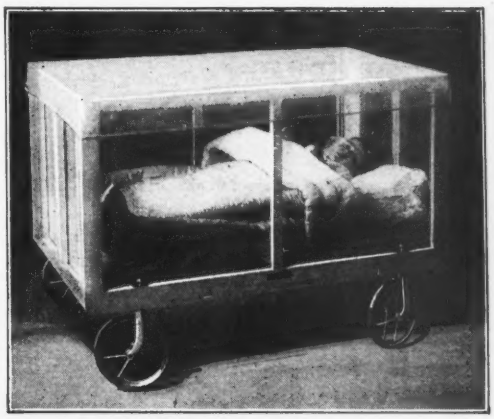
Now the most tempting food, in the form of strong-scented pine needles, was close at hand. By deviating only a very few inches from the beaten path, the hungry caterpillars could have obtained nourishment, but, like the blind adherents of a religious faith, they kept up the march unto the end.

Not a single one of the caterpillars had the initiative, the intelligence, to emancipate itself from the compelling power of the instinct which had come to it from countless generations of ancestors.

Plant Vegetable Seeds in Used Paper Cups

WHEN a paper cup has been used, it is generally regarded as fit only for the waste-basket. But out in Nashville, Tennessee, there is a drug-store proprietor who conceived the idea of making such cups useful for the planting of seedling vegetables of various kinds. He saves all those that have been used at his soda counter and turns them over to truck gardeners who are glad to make use of them. The plants are started indoors in these paper cups and afterwards transplanted outdoors without disturbing the roots.

Such paper cups are just as serviceable as earthen pots and have the additional merit of costing next to nothing.



The tot sleeps in comfort and safety, unannoyed by drafts or insects

The baby can stand in its crib, happy and contented, because at liberty to exercise its limbs

---

What to Do with Old Tea-Kettles. Make Them Into Flower Pots

WATER boils at 212 degrees Fahrenheit at sea level. On top of a mountain it boils at a lower temperature, because of the lesser pressure of the atmosphere. You can make water boil at ordinary room temperature with the aid of a vacuum pump.

All this explains why the boiling of water in the San Bernadino Mountains in California was a problem. Tea-kettles fill up with limestone very readily. Usually there are two or three kettles to be found in the junk pile of every homestead.

H. L. Thompson, of Waterman Canyon, has found a way of making them into hanging flower pots.

A tea-kettle doing artistic duty after its days of kitchen service

Combining the Baby-Crib with the Play Pen for Safety and Comfort

HERE is a novel crib and play pen combined, in which the mother may safely leave her baby while attending to household duties—thus relieving herself of much worry.

When asleep, the screened top and sides guard baby effectively against drafts and insects; when awake, the top is removed so as to give the baby free play to use its limbs. The sides admit light and air, and are so high that they prevent the child from toppling out when looking for a toy. The rubber-tired wheels work on swivels when the bed is to be moved about, and can be made stationary when desired.

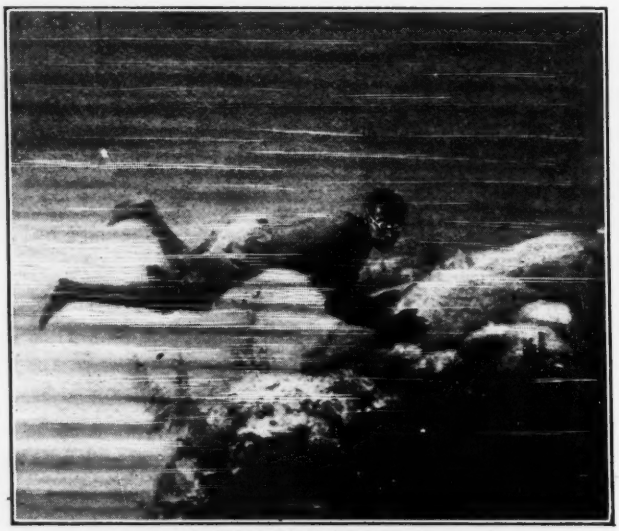
Spectacles to Help You See Under Water

Why you can't see under water as well as in air and how properly designed spectacles will help you

By Lindley Pyle,

Associate Professor of Physics, Washington University

PLUNGE the face with open eyes under clear water. Distinct vision is an impossibility; distant and near objects are alike blurred. The immersed eye is afflicted with a formidable case of far-sightedness, and it is powerless to accommodate itself to the extraordinary conditions of contact with a liquid medium. A brief consideration of a few well-known facts of physics and of anatomy points the way to the nature of the handicap and its remedy.



Spectacles That Make the Swimmer See

The spectacles worn by this swimmer make the rays of light converge to a point one and one-half inches behind the cornea. If it were feasible to place the lenses in direct contact with the cornea, this focal length could be reduced by one-fourth of an inch. The lenses make vision under water normal. A diver encased in his special suit would not require the use of such glasses, since his eyes are not in direct contact with the water

The human eye is essentially a sac of watery liquid, the front wall of which (the cornea) is a thin, tough, transparent, spherical membrane. It is unnecessary to detail the functioning of the iris and the crystalline lens which are found in the eye fluids behind. Suffice it to say that when the normal eye in contact with air is focused upon a distant luminous point the light rays sent to the eye are refracted (changed in direction) so as to converge toward a point one and one-quarter inches behind the cornea. The converging refracted rays do not continue their direction toward this point; they suffer a further refraction in traversing the crystalline lens and ultimately converge to a point on the retina, or rear wall of the eye-sac.

If the medium in front of the cornea be water instead of air then refraction in the eye system occurs at the crystalline lens only. Light rays will now traverse the cornea with no change in direction, for the bending of a ray traversing the boundary between two transparent substances arises from a difference in the velocities of propagation of light in the two substances. Since, in the case of the immersed eye, there is no sensible difference between the velocities of light propagation in the water before the cornea and the fluid behind it, light rays will not be deviated in traversing the cornea. Even when operating with its maximum refractive power the crystalline lens alone is too weak to do other than merely converge a bundle of rays to a point far behind the retina. In short, the normal eye in contact with water becomes markedly far-sighted.

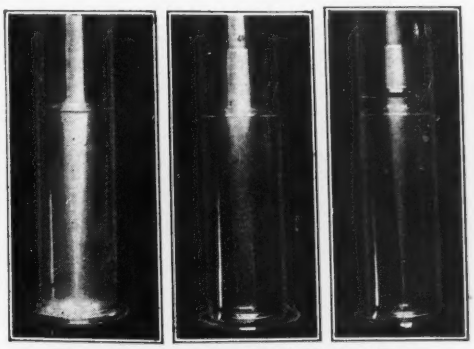
With the case properly diagnosed the prescription is easily written. Rays from a distant point must be made to traverse the immersed cornea as if to converge to a point one and one-quarter inches behind the cornea. A convergent lens of glass whose so-called focal length is one and one-quarter inches *in water* will restore normal vision provided the

lens be placed in contact with the cornea (a rather painful procedure). If the corrective lens be placed one-fourth inch in front of the cornea, its focal length *in water* must obviously be one and one-half inches; if three-fourths of an inch in front, then two inches, etc. It is desirable to hold the corrective lens as close to the cornea as possible in order not to narrow unduly the angle of view; for lenses of the focal powers mentioned are necessarily small in size.

Assume as the ideal adjustment a corrective lens held one-fourth of an inch in front of the cornea, the focal length of the lens *in water* being one and one-half inches. If the lens be constructed of ordinary optical glass its refractive power *in air* is four times as great as in water, and its focal length *in air* is but three-eighths of an inch. Such a lens would certainly measure across the face not more than one-third of an inch. The unusual appearance of the submarine spectacles of the accompanying illustration is not therefore due to a caprice of the illustrator. The smallness of the lenses has one redeeming feature in that the diver, before entering the water, may see all objects clearly by peering over (or under) his lenses, whereas, under water, vision is possible only when gazing straight ahead.

With normal eyes equipped in the manner described, a swimmer under water may focus his eyes at will upon any object, be it near or far, just as he does in everyday life.

Submarine spectacles should constitute part of the equipment of every aquatic-sport enthusiast. They should find a wide and useful application in all kinds of under-water work such as the clearing of fouled propellers, the collection of corals and sponges, and pearl-fishing.



Why You Can't See Well Under Water

At the left are shown parallel beams of light-rays brought to a focus by a watch crystal (representing the cornea) suspended in a tall jar filled with water. The crystal must rest on the water with no air beneath it. In the center is shown how the addition of water above the crystal destroys refraction; and at the right is shown how a strong lens placed in the water above the watch crystal will make a beam of light converge to the same point as in the picture at the left

The Lesson in Productivity Taught by "Poverty Bottom"

PROFESSOR W. SOMERVILLE, an English scientist, has been conducting some highly successful experiments in the reclamation of farms of low productivity. A large percentage of English farms are located on a chalky foundation, with but a thin layer of fertile soil. Selecting one of the poorest of these farms, aptly named "Poverty Bottom," the scientist found that, by clearing off the gorse, applying basic slag, and sowing clover on the soil he could effect a material improvement. Cattle on the pastures helped to raise its productivity three hundred per cent in six years.

French Fort, Like Anthracite Mine, Has Artificial Ventilation

A FRENCH fort at Verdun has artificial ventilation. It is described by Major-General Charles A. Clement, U. S. A., who visited the firing line. A fort, looked on as the best that French engineering skill could build, was made of reinforced concrete, extending many feet under ground, and stood near the site of the stronghold referred to. It was smashed to atoms by the Germans, but the French, even as the pieces were flying about them, constructed a new subterranean fort of rock and granite which effectually resisted the attacks of the enemy. This fort General Clement describes as somewhat resembling an anthracite coal mine. He said that the air in the fort's hospital was pure and, despite the fact that no sunlight ever penetrated the place, the conditions compared favorably with those of similar institutions on the surface of the earth.

The foregoing description gives us a glimpse of French efficiency displayed in their defense of Verdun.

Revolutionizing the Collar Industry

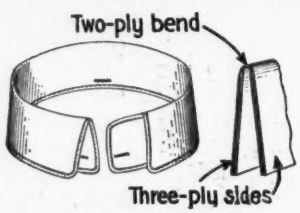
An indestructible collar appears. It is soft but stands up as if starched

STARCHED collars are complicated in the making, uncomfortable, short-lived, and expensive because of the laundry charges entailed. Hence the increasing use of the soft collar. Now the starched collar is neat—the soft collar is not. Wanted: A collar which is soft but starchless, which looks like the conventional starched collar, which can be cheaply laundered without skill, and which can be manufactured simply and inexpensively.

Have you ever stopped to think of the starched collar's crudities? A rigid band around the neck, with an outer surface greater in length than the inner to enable the cravat to slide freely (which it seldom does); its stiff edges soon fray neckties and wear holes in the shirt front; it must be laundered frequently at ever-increasing expense, and it shrinks in the process; early in life it begins to crack and chafe the neck, necessitating speedy removal.

The starched collar of convention has changed in no essentials, has been static in method of manufacture, in material and in discomfort, since the wife of a Troy blacksmith first made separate collars way back in the year 1825, the idea being exploited by a Methodist minister. Various plies of material are cut into small pieces, the edges are turned by machinery and stitched together, and then the whole is glued together with starch—a matter of ninety different operations, it is said, the greatest number of which require skill.

The multi-ply fabric from which this collar is made is woven in one piece



This soft collar has the virtues of starch without its faults

Now comes J. M. Van Heusen with a seamless collar which can be manufactured in five major operations, which is made of multi-ply fabric, specially woven in one operation and tied minutely together on the loom. In other words, there are not several separate fabrics stitched and stuck together. The accompanying drawings show the manner in which the new Van Heusen collar is woven.

The collar is of the folded or turned-down type, and because of the way the fabric is woven it is adapted to receive a curvilinear set and at the same time be smooth and without folds or wrinkles on either its outer or its neck-band surface. The fabric has sufficient "body" to permit it to retain its upright and circular contour, without the use of starch or other stiffening agent. It is flexible enough to accommodate itself to the movements of the neck, so that it has none of the stiffness of the standard laundered collar. It is not affected by perspiration; for it will not shrink in washing. Furthermore, the fabric is so constructed along the folding or wearing edge that no undue strain or wear is placed upon the fabric along that edge.

The laundering of the present day collar is a process which requires a score of operations, and the waste and use of much starch.

Starch for laundry purposes was recently prohibited by Lord Davenport, the British food controller, for the reason that "all the potatoes and corn that the

United Kingdom can raise are needed internally to stiffen the resistance to the Germans and none can be spared for external purposes." Right in this country hundreds of thousands of tons of food starch can be saved yearly by the elimination of starch from collars.

Nuts Equal Round Steak in Food Value

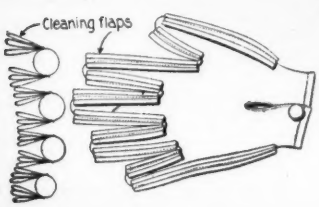
POUND for pound, walnuts, butternuts, chestnuts and hickory nuts are the equal in food value of a juicy steak, contain more protein (tissue building) food than white bread and but one-third less than eggs. In these days of food scarcity and high prices, it is likely that the vast crop of native American nuts will receive the recognition that they deserve.

The Butler's Glove Appears—A Japanese Invents It

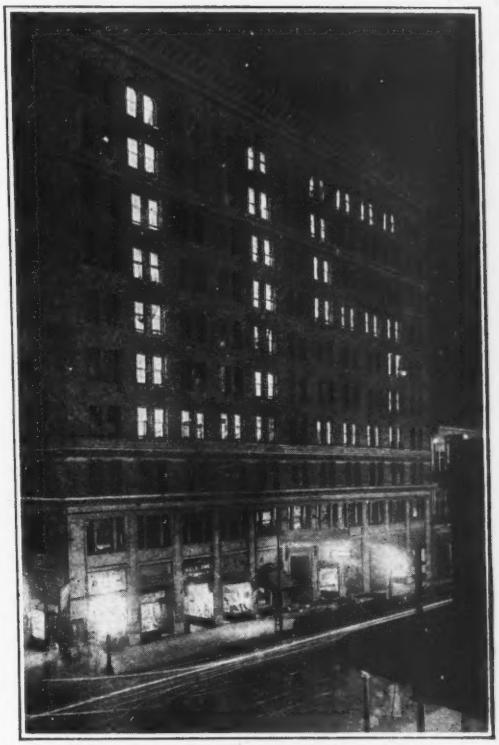
A JAPANESE in Los Angeles has patented a glove which in his opinion will prove invaluable to the "buttling" fraternity for all kinds of service where a dust cloth or polishing cloth is generally used.

The glove is made of any suitable material in the manner of an ordinary glove. Along the inner finger seams are a series of parallel flexible plaits, arranged three to the seam. These are attached so that they can be put aside when it is desired to grasp anything with the fingers.

The gloves are simply slipped on, and the polishing is done with the hands. Of course, we presume that the same glove will not be used to polish boots and silver, so that a number of pairs will be required.



A butler's glove made of soft material for polishing things



Patriotic illumination of office windows in Fresno, California, showing the initials of Uncle Sam's glorious name

"U. S." Spelled by the Illuminated Windows of an Office Building

FOR the Fourth of July or other patriotic celebration many cities might well copy the plan devised by an ingenious Californian who lighted up the windows of one of the large office buildings so as to form on a large scale the letters "U. S." The only requirement was the lighting up of the proper rooms in the building. A thousand watt lamp for each room sufficed. A few of the offices which were not required for the display and which had to be used were effectively blotted out by drawing the shades closely.

The Farmers' Motor Express

How motor trucks help to solve the food problem in Maryland by making the return trip profitable

By Joseph Brinker

The tagged can will be picked up by the truck

THE motor truck, operated as a rural express carrier, promises to contribute materially to the solution of the food problem and of some other difficult problems, which owe their origin to the existing war conditions. The system has already been tried out in Maryland with results which are highly satisfactory.

Rural Express Companies Are Licensed

The Maryland Public Service Commission issues exclusive licenses to truck owners to operate their vehicles over certain fixed routes, provided the owner agrees to maintain the schedule arranged and to increase his equipment, if necessary, to carry all the goods offered for shipment on his particular route. If the route holder subsequently fails to meet these conditions, his franchise is taken away by the commissioners and given to another contractor.

At this writing there are not less than twenty-three such rural express companies operating on as many Maryland routes. They employ thirty-one motor trucks, which, together, cover daily on an average 588 miles and carry seventy-five tons of farm products. The longest route is that between Fredericksburg and Baltimore, a distance of forty-seven miles.

Solving Washington's Food Problem

Some of the routes run from the rich agricultural districts of Maryland to Washington, where the food situation has become very acute. The population of Washington has increased by one hundred thousand during the past year, but the facilities for bringing food to the capital has not been adequately enlarged. There was food enough within fifty miles from the city, but before the introduction of the rural express motor trucks it was practically inaccessible. Maryland's routes have proved so successful in carrying food products of every kind, such as butter, eggs, milk, green vegetables and even live stock, from the farms directly to the markets in the city, that additional routes are being operated to bring the farm products of the rich country in northern Virginia to the markets in Washington. The trucks, returning from the city, take back loads of goods needed by the farmers. Hence trucking is made more profitable and efficient and more attractive for both sides.

Picking Up Live Freight in Passing

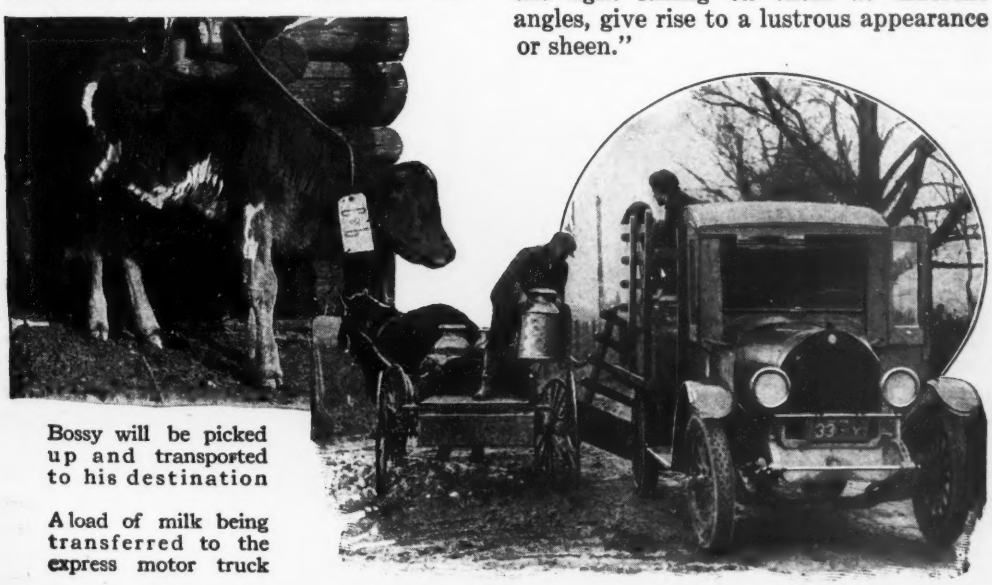
The great variety of things which these trucks collect along their route for transportation to the city is astonishing. At the first stop the driver may find a hog awaiting his coming. The animal is tied to a stake and has a tag with name and address of the sender and the destination of the live freight tied to its neck or tail. At the next farm the truck's load may be increased by a properly tagged calf and a crate of chickens or geese. A basket of eggs and perhaps a hog or two may be the contribution of the neighboring farm. The next may contribute a few tubs of butter and a crate of cheeses. All along the road the driver finds Y-shaped posts. Suspended from the crotch of the post there is almost invariably a tagged can filled with milk or cream destined for the city market. The driver collects these cans, loads them on his truck and on the following day brings them back empty to the sender. When shipments are made by railroad the farmers, as a rule, have to wait three or four days for the return of their cans.

Canned milk to be shipped to market is simply left by the farmer on the route of the express trucks, properly labelled for shipment to the city. Likewise, if a

cow or a calf is to be transported, all that is necessary is to tag the animal and leave it tied to a post on the route, to be picked up by the express driver and carried to its destination.

Number of Handlings Are Reduced

Such routes have a tendency to reduce the cost of food because they reduce the number of handlings. Each handling adds to the cost of any article, be it food or manufactured product. As an example, it requires at least fourteen handlings to get a case of eggs from Vineland, N. J., to New York city by present rail express routes. First there is a haul from the farm to the railroad station; then comes loading upon the express cars, followed by transferring the goods from one line to another. When the produce reaches New York, there is a haul to the wholesaler from the railroad station and another to the final consumer. By truck, these fourteen operations are reduced to two, from the original producer to the final consumer, with only six persons handling the goods. As another example, mushroom growers in Oxford, Pa., had to ship their goods one hundred and ten miles by rail to get it to Philadelphia in about two days or forty-eight hours. By the rural express truck, the road distance between the two points is only fifty-five miles or just half, and the run can be made from the grower to the eater in about four hours or one-twelfth the time.



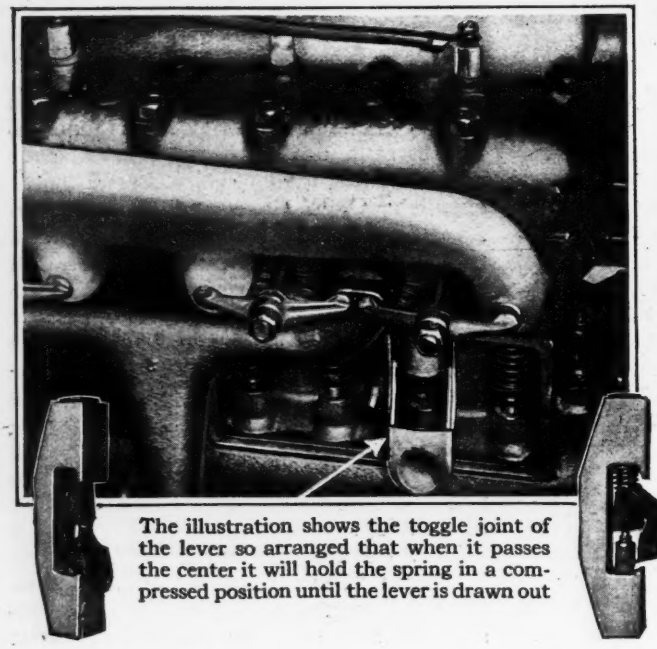
Bossy will be picked up and transported to his destination

A load of milk being transferred to the express motor truck

Your Silk Socks May Once Have Been a Tree

THE method by which most of the artificial or imitation silk is made at the present day, the so-called viscous process, was invented by two English chemists, C. F. Cross and E. J. Bevan. As the basis of this process there is used wood pulp, prepared by the maceration and chemical treatment of wood. This pulp is treated with a solution of caustic soda and then with the liquid called carbon disulphide, whereby a thick syrup-like mass is obtained. By forcing this viscous material through minute apertures into a suitable liquid, silky filaments are produced which can be spun into fine or coarse threads suitable for knitting or weaving.

But, we are cautioned, in Alexander Findlay's "Chemistry in the Service of Man" (Longmans, Green & Co.) this artificial silk must not be confused with the lustrous material known as mercerized cotton, so-called after the discoverer of the process, John Mercer. "Cotton, in its natural state, consists of flat, twisted fibers, but when these fibers, tightly stretched, are immersed in a solution of caustic soda or soda lye, the fibers swell up, become untwisted, and assume a nearly straight, rod-like form. The surface of these fibers is covered with a number of smooth ridges which, reflecting the light falling on them at different angles, give rise to a lustrous appearance or sheen."



The illustration shows the toggle joint of the lever so arranged that when it passes the center it will hold the spring in a compressed position until the lever is drawn out

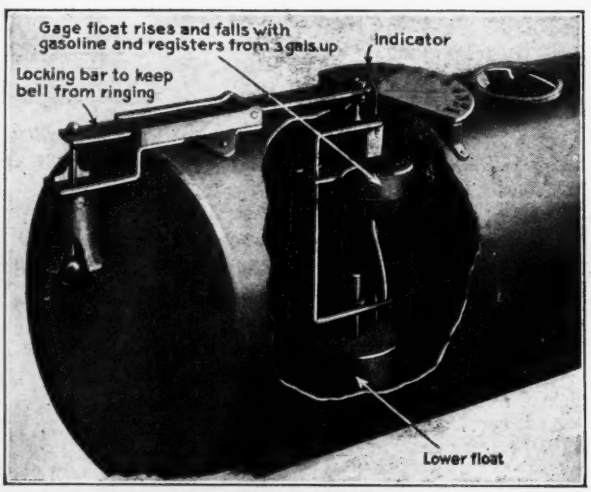
New Tool Makes Ford Valve Removal Easy

THIS lever-principle tool automatically compresses the Ford valve spring when pushed down, so that the pin at the bottom of the valve stem can be removed easily and the valve taken out for grinding. The cup-shaped part placed around the spring keeps the latter in a compressed condition until the valve is put back. The toggle joint of the lever is so arranged that when it passes the center it will hold the spring in a compressed position until the lever is drawn out. Being made of light sheet stock one or two of these can be carried in the tool box ready for any emergency. It certainly is a handy tool to have.

When Your Gasoline Gets Low the Bell Will Ring

REV. R. A. GOODWIN, of New Hampshire, has invented an attachment for registering the amount of gasoline in the tank of an automobile, and also for ringing an alarm bell when a predetermined minimum of two or three gallons has been reached.

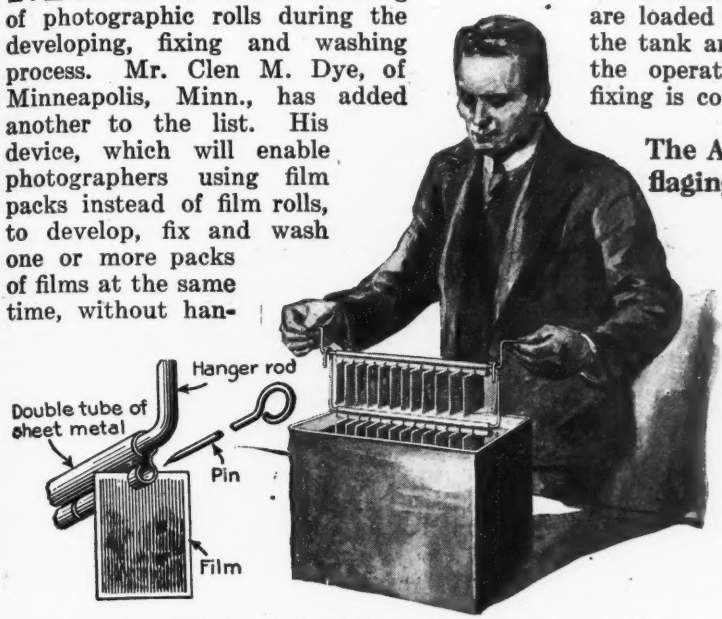
The device consists of two floats in an adjustable iron frame in the gasoline tank, and an indicator and bell outside. The upper float in the tank rests on the surface of the gasoline, and is connected with the frame so that it cannot itself rotate, but communicates its motion to the indicator through a metal spiral with a half-turn in it. The alarm mechanism is worked by the lower float. The mechanism consists of a bar, pivoted on the top of the tank, and carrying the bell-clapper at one end. The clapper is provided with a collar so that it can seat on the top of the bell and be rendered thus immovable. The other end of the bar, which extends a little beyond the pivot, is attached to the frame inside the tank. To the bottom of this is attached the second float, which can be screwed up and down a scale, graduated by experiment. As soon as the level falls below a certain point the float drops, the weight of the framework unseats the bell-clapper, which sounds an alarm with the jolting of the car.


Gage float rises and falls with gasoline and registers from 3 gals up
Indicator
Locking bar to keep bell from ringing
Lower float

An upper gage float resting on the gasoline actuates an indicator, while the lower works the alarm

Developing, Fixing and Washing Several Film Packs at One Time

MANY devices have been invented for the convenient handling of photographic rolls during the developing, fixing and washing process. Mr. Clen M. Dye, of Minneapolis, Minn., has added another to the list. His device, which will enable photographers using film packs instead of film rolls, to develop, fix and wash one or more packs of films at the same time, without handling each individual film separately.



A device useful to photographers who desire to develop, fix, and wash several packs of films simultaneously and quickly

A wire rod, bent so that its arms rest on the edge of the developing or fixing tank, is the support of the film-holding device. To this rod a tube is soldered, through which a long, thin pin can be pushed. The tube is provided with a number of slits, wide enough to accommodate the thickness of a film.

To load the holder, the pin is removed. After the first film has been inserted the pin is pushed in so as to pierce the edge of the film. Then the next film is placed in the second slit and the pin pushed through its edge. This operation is repeated until each slit contains a film These films are held in place by the thin pin upon which they are strung. Supplemental sections, similarly arranged to hold a number of films, may be loaded and suspended from the main section of the holder. After all the holders are loaded they are immersed in the tank and left suspended until the operation of developing or fixing is completed.

The Advantage of Camouflaging Transatlantic Ships

THE ship that is well camouflaged, that has no masts or funnels, that is driven by oil engines instead of steam, furnishes a poor target for the U-boat. It has been estimated that if all transoceanic ships were thus disguised, our enemies would need at least fifty submarines to patrol effectively a sea lane five hundred miles wide.

Spineless Cactus Leaves Become Attractive Sign-Boards

A LOS ANGELES nurseryman, who has an agency for the supply of spineless cactus, used as cattle feed, has hit on a novel method of advertising his wares. The plants themselves serve as a signboard, the advertising matter being written on the leaves. The passers-by read and then stop and feel the leaves to see that they are really spineless. As the illustration shows, the nurseryman is a first-class advertiser but a second-rate speller. In spite of this simplified spelling he has made his business flourish like his cactus.

Spineless cactus leaves are nutritious and palatable food for cattle

With Fin, Foot and Wing

Records of the swiftest animals

By Clifton Harby Levy

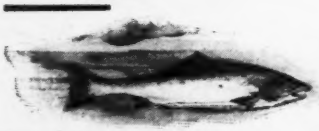
The snail easily holds the record for slowness of progress

Next comes the tortoise, famous for slowness in ancient Greece

The camel has marvelous endurance but only moderate speed

Santa's reindeer travel only about ten feet a second

The grasshopper in his jumps can make thirteen feet a second and not feel it



The salmon travels in the water at double the speed of a grasshopper

Man has been known to make as much as thirty feet a second in sprinting

But he cannot rival the antelope with its speed of forty feet or more for each second

IT was long claimed that the fastest animal in the world was the eider-duck, which cleaves the air at the rate of 150 feet each second. The ordinary wild-duck travels only at the rate of seventy feet per second, while the record of a carrier-pigeon is 124 feet a second established in a 100-mile flight in 1900. The bird traveled at the rate of 85.6 miles per hour. The record for a running horse on a mile straight-away is 1:35½, made by Salvator at Monmouth Park in 1890, or at the rate of 37.6 miles per hour. The fastest mile ever trotted by a horse was done by Uhlan (1:58) in 1912, while the fastest mile ever paced by a horse was done by Dan Patch in 1:55 (1906), or at the rate of 32.43 miles per hour. The record for a human mile over a full mile track is that made by Norman S. Tabor (1915) 4:12 3/5 or at the rate of 14:24 miles per hour. The greatest speed attained by any man is that of Howard P. Drew, who covered 100 yards in 9 3/5 seconds (March 28, 1914).

If Men Could Only Jump Like Fleas

If a man is to be compared with an insect in getting over the ground we shall have to mention the record jumps made by athletes, and note what the flea and grasshopper can do. R. C. Ewry has jumped 11 feet 4⅞ inches (standing broad jump) and 4 feet 11 inches (standing high-jump), but M. Prinstein covered 24 feet 1 inch in the running broad jump and S. S. Jones made 5 feet 11 inches in the running high jump. Prinstein also holds the record for the hop-step-and-jump (47 feet).

The flea jumps farthest in proportion

Where will they be at the end of a second? The black lines

to its size of any living animal, covering 200 times its length in a single jump. The speed with which it jumps has been measured as 9 feet 1 inch per second. But this speed has been surpassed by a small grasshopper without wings which measured only 0.273 inch and sprang into the air at a speed of 13 feet per second. Winged grasshoppers one inch long have been known to jump 15.6 inches high and 23.4 inches wide, or at the speed of 13 feet per second.

Man makes slowest progress of all in the water. The fastest swimmer, B. Kiernan, made a mile in 23:16 4/5, or at the rate of 2:65 miles per hour (3.7 feet per second). An English zoölogist claims that a salmon swims at the rate of 26.28 feet per second. It is estimated by those who have made a special study of fish and their speed in the water that most fish swim a yard or more a second. It has been possible to measure with considerable exactness the speed at which a whale can swim, by timing the running of a harpoon-line after a whale has been "struck." In this way it has been shown that a whale goes at the rate of between 10 and 15 feet a second.

Crabs Not Famous for Their Speed

A crab travels sidewise at the rate of 2.73 inches per second, unless frightened, when its speed is increased. A lobster travels more or less sidewise like a crab at a rate of 5.85 inches per second. A tadpole, half an inch long, swims 4.29 inches per second, and when an inch long swims 6.63 inches per second. A swan, when frightened or pursued, makes its way through the water at a rate of 44 inches each second.

Attempts have been made to train swallows as letter-carriers, on account of their great speed. It was claimed that in one race between a swallow and a carrier-pigeon the swallow flew four times as fast as the pigeon. The accuracy of this test has been questioned.

The Swallow Holds the Record for Speed

It has been proved, however, that the swallow does fly faster even than the eider-duck, cleaving the air at between 210 and 333 feet per second. This being so, it must be the fastest moving animal in the world, unless the unconfirmed figures of individual naturalists are to be accepted. Some claim that the blue-throated warbler travels at a rate of 363 feet a second, and the plover as fast as 436 feet a second. The Virginia rain-plover, it is asserted, traveled from Labrador to Brazil in one night, a distance of 800 geographical miles, or at the rate of 450 feet a second, the greatest speed claimed for any living creature.

The eagle crawls along by comparison, attaining no more than 75 feet per second, while cranes far outstrip them traveling 165 feet per second.

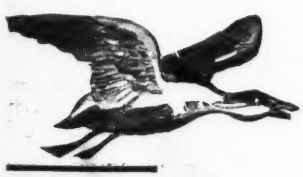
The Speed of the Soaring Birds

The soaring flight of birds, without flapping the wings, is directly dependent upon the spread of wing as related to the weight of the body. It has been found that the soaring ability of various birds is at the following speeds: Swallows, 9 to 11 feet per second; herons, 12 to 14 feet per second; cranes, 15 to 17 feet; silver-gulls, 16 to 18 feet; albatross, the greatest soarer of all, 20 to 23 feet per second.

The number of strokes of the wing, or flaps has also been studied and recorded, showing the following number per second: Fly, 330; humming-bird, 240; bee, 190; wasp, 110; sparrow, 13; wild-duck, 9; house-pigeon, 8; mouse-buzzard, 3.

It has been ascertained by careful observation that swarms of butterflies progress at a rate of from 35 to 39 feet per second. When flying quietly around a room a fly covers from 4 feet to 22 feet per second, but if pursued may fly as fast as 58 feet a second. A bat averages about 30 feet a second, and a flying fish covers 81 feet a second.

The record for a mile walk by a man was made in 1910, being 6:25 4/5, but



One hundred and fifty feet a second make the eider-duck one of the fastest creatures that we have any record of

But the swiftest of them all is the swallow with an average recorded speed of two hundred and fifty feet per second

by their length show the relative speeds of different animals

the average speed at which a man walks is not over three miles an hour. It has been estimated that a man weighing 150 pounds may cover 5 feet a second, without feeling great fatigue, for hours at a time, if in fair condition.

The Snail the Slowest of All

The slowest of all animals, as has been popularly believed, is the snail, which travels .06474 inch per second, taking five minutes to go 1.65 feet. In an hour it will go about seventeen feet, according to another authority. A little spider covers 2½ inches a second and a large one 4 inches. It has been noted that a spider, travelling over its tracks three times, spins a web at the rate of .11 inch per second. Larger spiders have reached a speed of 5 inches a second. The ordinary rain or earth-worm creeps .11 inch per second, and if pursued may triple this speed, or advance .33 inch per second. The ordinary black ant (*Latius niger*) moves at the rate of 4/5 inch per second when going about its regular affairs, but if pursued or frightened may cover 3 inches per second. The silk-worm spins a cocoon 991 feet long in 7 to 8 days, or at the rate of 130 feet a day. A rattle-snake moves over the ground ordinarily at a rate of 4 inches per second, but when pursuing its prey may go 20 to 40 inches per second. A rattle-snake 20 inches long, ¾ inch in diameter, has been observed to swallow several frogs 3 inches long and 1½ inch in diameter at the rate of one frog in twenty-four minutes. The frog usually moves at a rate of 3 inches per second, so he falls an easy prey to the swifter snake. A toad hops at the rate of 8 inches per second.

The Tortoise—a Classic Example of Slowness

The tortoise, 5 inches long, travels from .30 to .78 inch per second; a tortoise twice the size covers 1.5 inch per second; while the giant tortoise scrambles along at a rate of 2.8 inches per second. The hare, so often compared with the tortoise, especially in the famous fable, when doing his best may cover 60 feet a second. A reindeer, when drawing a sled, covers 10 feet a second, but a wild roe pursued by two dogs has been known to get over the ground at a rate of 74 feet a second. The antelope has no difficulty in going from 40 to 47 feet a second, but a tiger has been said to cover a short distance at the rate of 46 feet a second. The greatest speed of a wolf is set down as 30 feet a second. A fox travels something like 50 or 60 feet a second, when pursued. The record of English fox-hounds is 60 feet per second, and the fox kept ahead of them. Ordinary hunting-dogs usually attain a speed of between 33 and 45 feet per second.

Slow, but Sure, Is the Motion of the Ox

The ox is not famous for speed, being often compared with the snail, but when pulling a plow he goes at a speed of 23.5 inches per second and when pulling a wagon, at a rate of 29.4 inches per second. The elephant when running wild may cover twenty feet a second, but when trained will pull a heavy load at the rate of 4 to 5 feet a second, on account of his great stride. A dromedary has been known to cover 86.8 miles in a day of 16 hours. Brehm, the German naturalist, claims a record for some dromedaries of 119.73 miles per day, and states that the ordinary speed for a properly equipped caravan is about 25 miles a day.

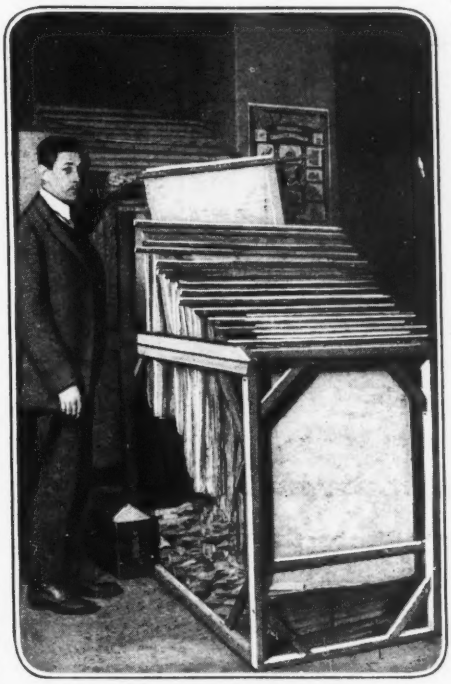
Naming Trenches After Manhattan's Streets and Avenues

IT must have been the trench-like condition of the streets of Manhattan during the progress of constructing the subway systems that suggested the propriety of naming the trenches of the training camp at Spartanburg, S. C., after the streets and avenues of New York city. Under that system the battery positions are regarded as the South end of Manhattan Island; hence this general locality is known as Battery Place. The reserve trench is known as Wall Street, the two supporting trenches as Forty-second Street and Fifty-ninth Street and the two fire trenches as 116th and 125th Street. The foreground, or No Man's Land, is the Bronx. The leading artery of approach is known as Broadway. East of it follow Fifth, Third, Second and First Avenues, west of it Tenth and Eleventh Avenues. Diagonal trenches are named after Park Avenue, Columbus Avenue, etc., and the short ones are named after some distinguished American soldiers.

Storing Maps and Plans in an Ingenious Rack

AS county engineer of Erie County, New York, Mr. George C. Diehl naturally has to keep by him for immediate reference a large number of road plans, maps, etc. Finding that the number was growing out of all proportion to the space at his disposal, he cast about for a more compact means of storing them. The rack which our illustration depicts was the result.

It is merely a framework of two by four lumber, with the top rail sloped at an angle of about thirty degrees. Pegs are driven into this top rail at intervals of about two inches. The maps and plans are clipped between two laths along one edge, and the titles are written plainly on the laths. The mounted map is then placed in the rack, and the laths scotched behind a pair of the pegs. Kept in this way the titles can be readily scanned, and the maps are available for immediate use. In addition they take up much less space in the office than if they were just piled up promiscuously.



A handy way of keeping mounted maps so they can be got at with a minimum of effort and trouble

An improvement to this contrivance may be suggested after a glance at the illustration here presented. To prevent dust from getting onto the maps it may be well to box in the sides with cloth or canvas and contrive a movable cover of the same materials for the top that may be raised or lowered.

A Pencil That Will Write Your Name on Your Shears

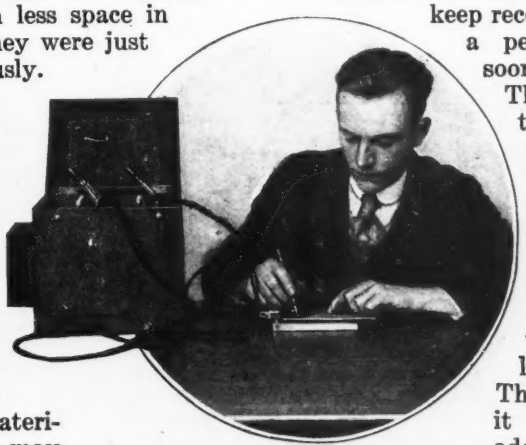
THE office worker whose shears or paper-knife disappears mysteriously sometimes to reappear on the desk of another, sometimes to vanish altogether, will welcome the electrical engraver. It is a device which will enable him to write his name—just as he would use a pen or pencil—on any article of steel.

In an oak case is a transformer, the primary circuit of which is connected with a source of alternating current. A special resistance is inserted in the secondary or lighting circuit to regulate the depth of the engraving.

Connection is made with the pencil and the metal plate on which the object to be engraved is placed. Bringing the copper point of the pencil into contact with the steel completes the circuit. Intense heat is generated at the pencil point with the result that the steel is burned away wherever it is touched.

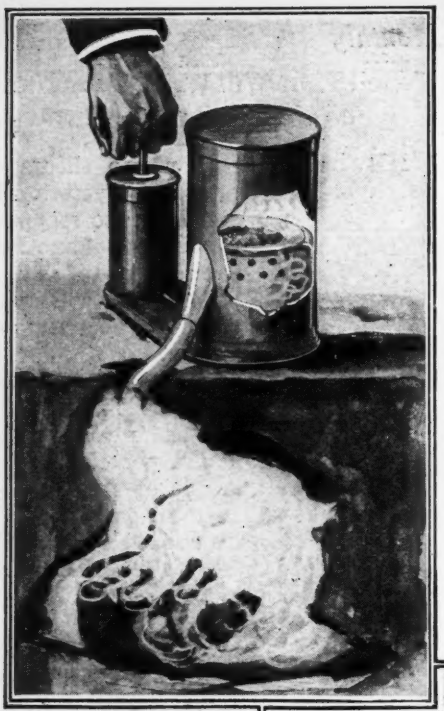
This device makes it possible to keep records on cuts where a pen notation would soon be obliterated.

There can be no question of its value to the jeweler or the professional engraver, who will doubtless welcome the advent of a new and efficient instrument that will render their labor much easier. The ease with which it is operated is an additional recommendation.

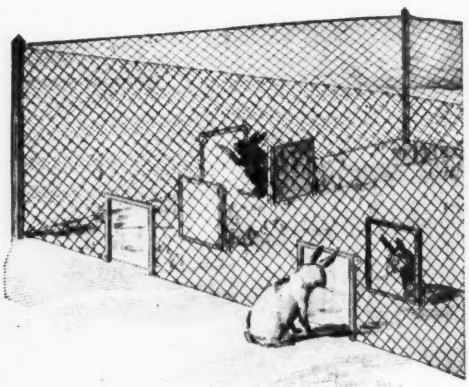


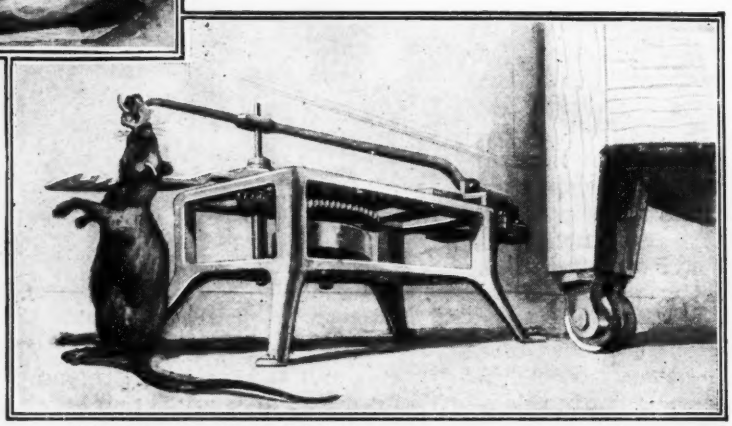
You engrave your name on steel as easily as you write with pen and ink

When Man Plays the Role of Hun in His Warfare Against Rats

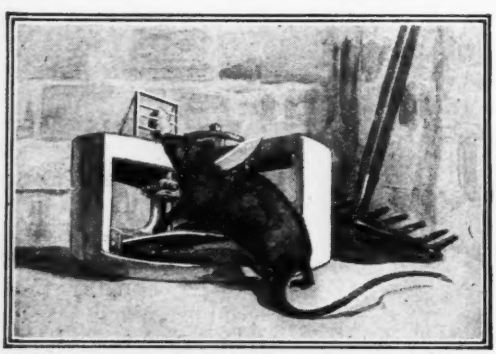


Poisonous gases of combustion, generated in the portable stove, are forced into the rat holes by an air pump, killing the rats. This gives rise to another problem, i. e., how to get the dead rodents out of their holes

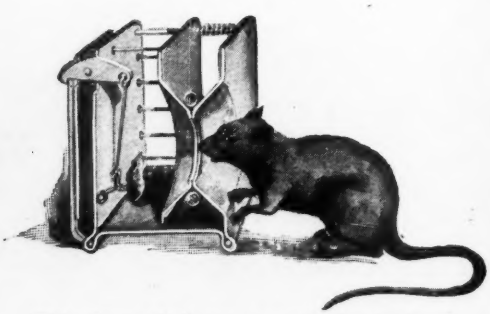




When the rat nibbles it is killed and flung away by a spring-propelled saw-tooth arm which is automatically reset

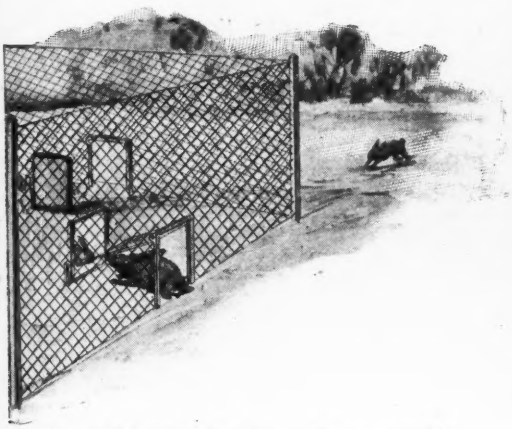


Here a spring-propelled rotary knife beheads the unsuspecting rat neatly and painlessly when it tries to reach the bait



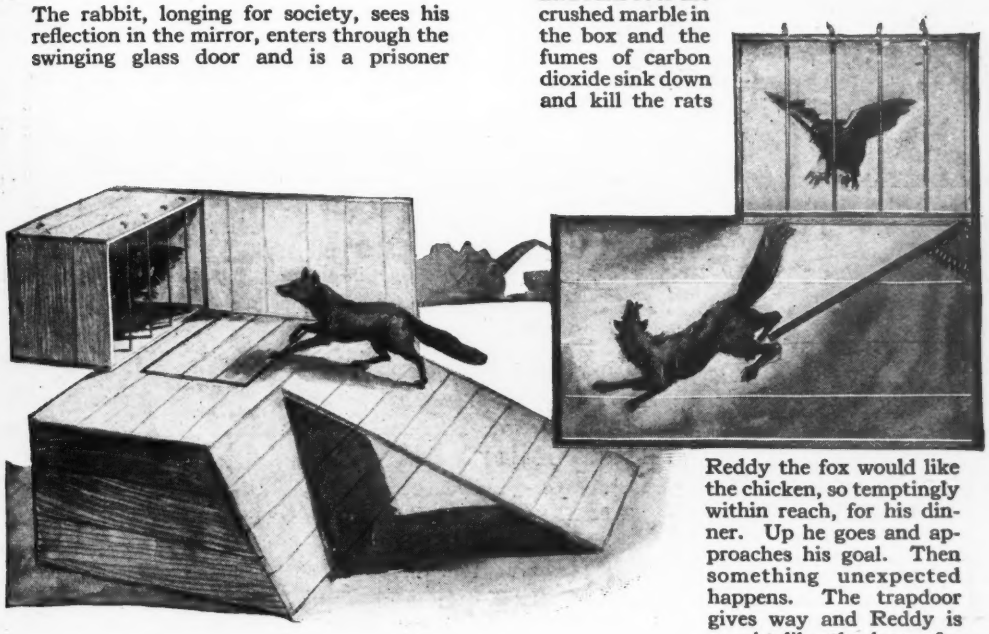
This shows the hungry rat poking its head into the funnel-shaped opening, shown here in cross section, and losing its head

He Gases Them and Traps Them in Regular Teutonic Fashion

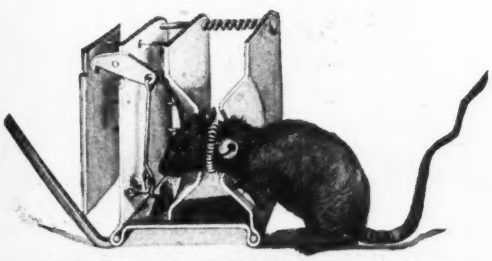


The rabbit, longing for society, sees his reflection in the mirror, enters through the swinging glass door and is a prisoner

A blow breaks the bottle, the acid runs over the crushed marble in the box and the fumes of carbon dioxide sink down and kill the rats



Reddy the fox would like the chicken, so temptingly within reach, for his dinner. Up he goes and approaches his goal. Then something unexpected happens. The trapdoor gives way and Reddy is caught like the hero of a blood-curdling melodrama

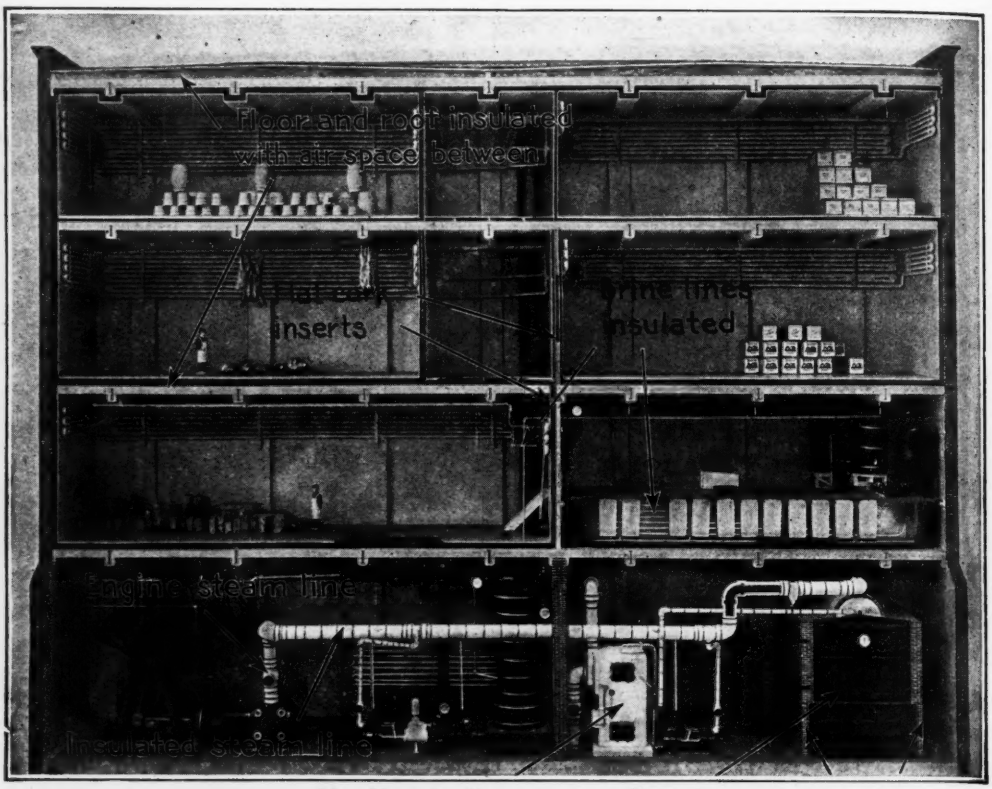


As he touches the bait, the two ring-shaped sections separate and a spring collar with bells slips around the rat's neck

When he returns to his family with this noisy ornament, thus forced upon him, he will cause a good-sized wild stampede

Keeping Out Heat

**Insulation is the great problem in cold storage—
How cork is used to cover the pipe lines**



This cross section of a modern cold storage warehouse shows clearly the method employed for insulating the cooling spaces against the intrusion of unwelcome heat from the outside

IT is a fact, although not generally well known, that three-quarters of the work of the refrigerating machine in any cold storage plant is spent in removing or neutralizing the heat that seeps in through the floors, walls and ceilings. Only one-fourth the work is spent to cool the goods in storage. If ice is used, seventy-five pounds out of every hundred put into the cooler is melted by the heat that comes in from all sides. That is clearly an enormous waste which demands prompt attention.

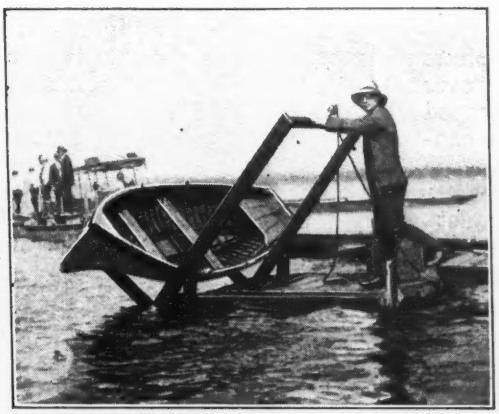
The importance of wall, ceiling and floor insulation at once becomes patent. The method of keeping a great percentage of this warm air out is clearly shown in the accompanying cross-sectional view of a modern cold storage warehouse of three stories and basement.

Beginning way down in the cellar, even the steam lines, feed water heaters, boilers and the plant auxiliaries are insulated, as are all the floors, walls and ceilings. The brine coolers and brine pipe lines are similarly covered. Sometimes cork is used to keep the cold in and the heat out. It is made up into semi-cylindrical strips for the pipes and in flat board-like pieces for the walls and ceilings. In the case of concrete floors, the cork insulation is placed directly on top of the wooden forms before the concrete is poured into them.

Washing Machine for Boats. It Does the Work of Two Men

NO electric motor is attached to the boat-washing machine, but the device, as perfected by a liveryman of Devil's Lake, Michigan, is just as useful as an elaborate washing machine of any kind.

The machine consists of two beams four-inches square, held a few inches under the water and attached to a lever made of two two-by-four beams, which, when the machine is in position to receive the rowboat, stand almost upright. Attached to these levers is a block and tackle used in the first part of the operation of placing the boat in position for washing.



The boat is lifted out of the water for a good cleaning, and one man can do the job

In use the boat is floated onto the two submerged beams, the block and tackle is put into action and the boat lifted out of the water and turned over on its side. In this position it is easily cleaned.

Bumping the Bumps for the Fun and the Exhilaration It Gives

NOTHING makes a playground more attractive for the kiddies than one of these wavy coaster slides shown in the picture. In two lines the children file up the divided stairs. Having reached the platform at the top, they slide down again on one of the two slides which lead to the ground in opposite directions. What fun! Quickly the little ones descend upon the smooth surface of the sliding trough, and the bumps they get in passing over the tops of the gentle waves add to the zest and exhilaration of their pastime. Glowing with excitement and pleasure the children return to the stairs for another turn at the slide, and they never seem to tire of the sport.

But, even older and really old persons are by no means proof against the allurements of this form of amusement.

Sit down, slide down, come down! The bumps give you the ups-and-downs of life. If you are old, they make you feel young. If you are young, they enhance your enjoyment of life

A Coat of Mail? No, It's a Canvas Shield for the Iceman

THE lithe Italian who handles ice in summer and coal in winter does so with utter disregard of wet and dirt. Charles G. Sagerstrom, of Chicago, is trying to market a shield for protecting the iceman's clothes. This shield consists of two waterproof breast pieces which are thrown over one shoulder and strapped into place. A double canvas shoulder strap connects the two pieces at the top. The steel epaulet has teeth cut into it to prevent the burden from slipping.

Keeping his shoulder dry with the new protector

Gasifying Kerosene in the Farm Tractor

ALL motor-vehicle and motor-tractor owners would like to use kerosene as a fuel instead of gasoline because of the cheapness of kerosene as compared with gasoline. Unfortunately, engineers and inventors have not been able to design satisfactory means whereby kerosene can be burned with as good results as gasoline.

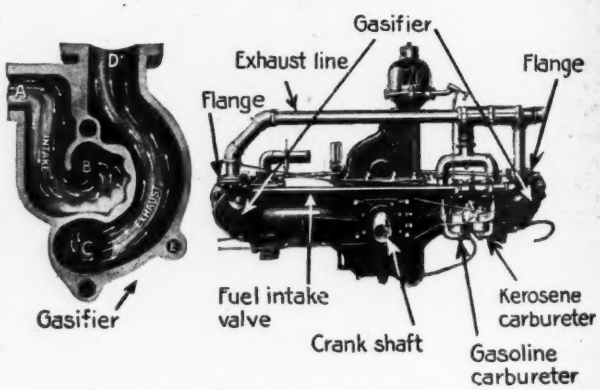
The trouble is that the kerosene can not be entirely vaporized, that is, turned from a liquid into a gaseous state. Kerosene is heavier than gasoline.

Then again, kerosene has some constituents which vaporize at one temperature and others at a still higher temperature so that unless the maximum amount of heat is supplied to vaporize the least-volatile portions, they get into the engine as fluids and destroy the engine lubricants by working down past the pistons into the oil reservoir in the engine crankcase. Even if some of these liquid portions are burned, they do not give up the same amount of power as when mixed with air to form an explosive mixture and result in carbon deposits.

While the problem of burning kerosene in internal-combustion engines on farm tractors is by no means solved, the gasifier shown in the accompanying illustrations gives fairly good results. The use of kerosene, even with the gasifier shown, is not as economical as gasoline, as was demonstrated at the tractor trials of 1917. It is much more difficult to vaporize kerosene than gasoline on account of the heavier constituents of the former fuel. Heat applied to kerosene will assist it to break up into a gas more readily, and this is just the principle of operation of the gasifier shown.

The device consists of an irregularly-shaped hollow casting fitted to the head of each of the two horizontal engine cylinders. The casting is divided into two main parts, as shown in the sectional illustration, by means of a thin serrated wall. The hot exhaust gases pass out on one side of the wall, heating it so that the fuel, which enters on the other side, is heated and gasified before passing into the cylinders.

The substitution of kerosene for gasoline is simply a question of comparative cost. Does this gasifier, which must be expensive, solve the problem?

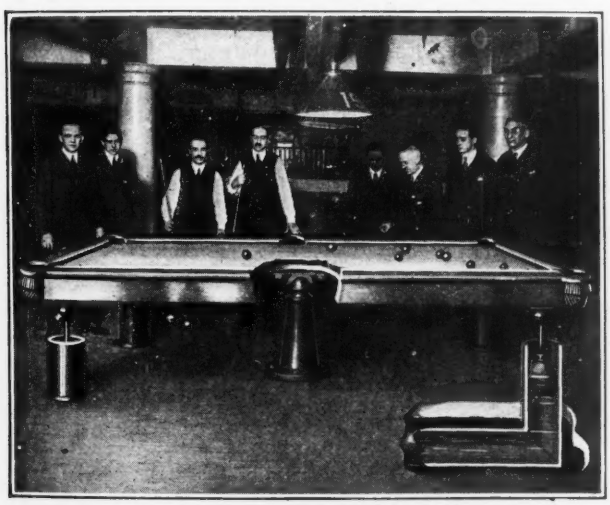


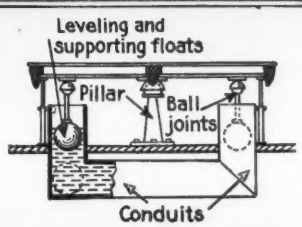
With a sufficient heat supply this gasifier makes kerosene available as automobile fuel

Ship's Billiard Table Like a Carpenter's Level

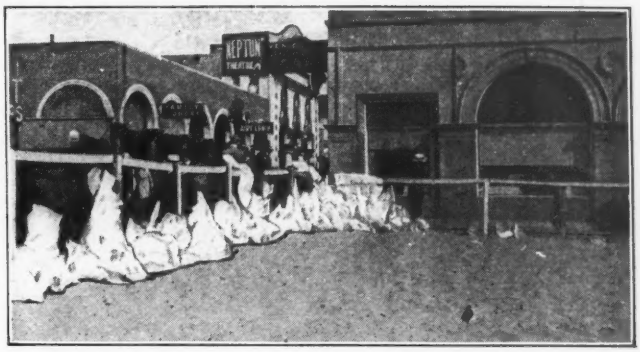
JOHN FRANCIS BOOTH, of New Zealand, has obtained a patent upon a device invented by him, in which he makes use of the principle of the spirit level to give a billiard table on board of a ship a horizontal level undisturbed by the rolling and pitching of the ship.

In its center the table is supported by a pillar, the top of which has a ball and socket joint. Beneath each corner of the table is a vertical cylinder, filled with water, and these four cylinders are interconnected by conduits of a cross-sectional area equal to that of the cylinders. Extending downward from each corner of the table is a vertical bar which has at its lower end a float slightly smaller in diameter than the cylinder. These floats rest upon the water in the cylinders and communicate the changes of level to the table. This billiard table will be appreciated by travelers who are fond of billiards, but can't stand the ship's pitching.





Cross section of billiard table showing the arrangement of the supporting floats. In the diagram is shown how the cylinders are arranged; also the ball-and-socket support in the center and the vertical bars



Showing how waste-paper is prevented from blowing about at random by a wire fence high enough to keep it confined

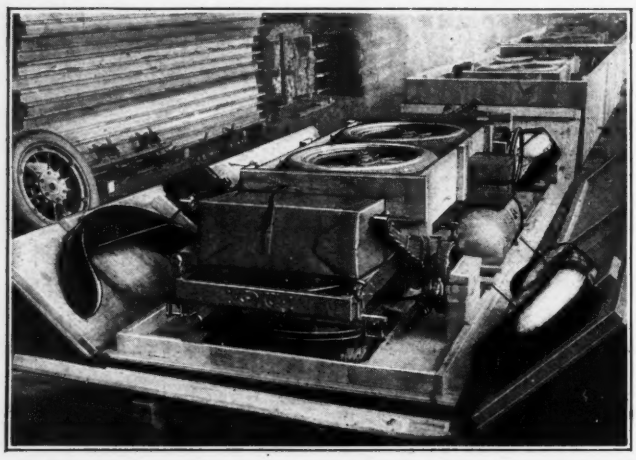
Building a Fence to Keep Out the Old Newspapers

AT one of the popular resorts, during the season, the proprietors of the various restaurants and beach establishments found that they were suffering from an invasion—not from anything of flesh and blood, it is true, but from newspapers. The wind blew up the old papers left lying on the beach by visitors, and littered up the open spaces. To cope with the nuisance and repel the invaders, battlements of wire netting were erected along the edge of the boardwalk. Here the would-be invaders rustle and crackle in vain, as our illustration shows.

Aside from the unsightliness of such fluttering paper; there is a real hygienic reason why old newspapers should be prevented from blowing about, as they have gathered filth as they went along.

Wood Fiber Used in the Making of Gas

IN France and Switzerland sawdust and wood have lately been experimented with for gas-making. Ten per cent of sawdust added to coal, it is reported, has given good results in Geneva; and logs of wood have likewise proved satisfactory for the same purpose. Condemned flour was carbonized at Royan and produced a good quality of coke.



To save space army motor trucks are packed for shipment to French seaports within a narrow compass

most ingenious manner. The springs are disconnected at their ends, but not at the axles; the driver's seat, the gasoline tank and the wheels are crated separately; the engine is left in its place in the frame, but is well protected and the axles are securely chocked.

The accompanying illustration giving a clear idea of the manner in which an army truck is taken apart, crated and stowed in the hold of a ship shows how valuable space is saved by Yankee ingenuity when spurred on by necessity.

How Motor Trucks Are Packed to Save Shipping Space

THE scarcity of cargo space in our transatlantic steamships confronted the Government with the important problem whether it would be best to ship our army trucks across the ocean completely mounted or to take them to pieces and pack them in boxes. The problem resolved itself into the question whether the saving of space pays for the cost of boxing and for the expense and loss of time connected with unmounting and packing on this side and unpacking and remounting on the other side of the ocean.

Some of our military trucks and those of our Allies are shipped completely mounted and packed between bales of hay in the hold, while others are boxed as shown in the accompanying illustration.

Especially for deck loads, the crate method is preferable, since it prevents the chassis and engine from being injured by the salt water that washes over the decks.

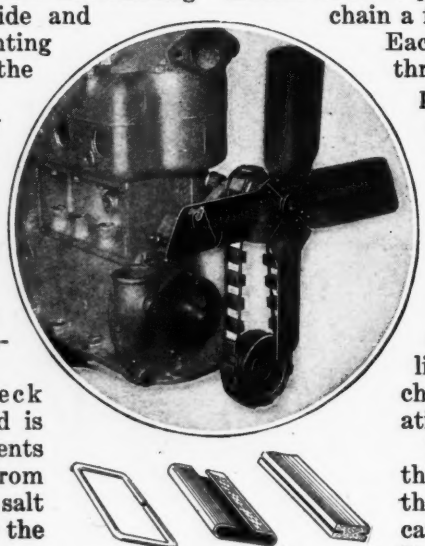
In packing the trucks the fenders are fastened in a

Oil, Heat and Water Do Not Affect This Engine Chain Belt

THE owner of a Ford car invented a new type of chain belt for the cooling fan, which is said to possess many advantages over the familiar leather or canvas belts heretofore used. Leather and canvas are affected by the oil, heat and water to which fan belts are invariably exposed. They stretch and have to be renewed frequently. The new chain consists of separable steel links and has leather contact plates which give to the chain a firm grip on the pulleys.

Each link is composed of three parts, a wire link, a pressed steel link and a sole-leather block, which is grooved and which, when slid into place, locks the links. At the same time a friction surface of great durability is supplied. The illustration shows the individual parts of a link and the complete chain in position for operating the fan.

The advantage of using this chain belt instead of the old-style leather and canvas belts is obvious. Its durability more than offsets its higher cost of manufacture.



This shows the three parts of which each link of the new chain belt is composed

That Dripping Varnish Brush—How to Gather Its Wipings

THE man who frequently uses varnishes or paints knows how drippings from the brush, containing hair, or cobwebs or dust contaminate the contents of the pail and prevent him from doing clean work. Even the housewife who only occasionally touches up a piece of furniture or a strip of flooring has experienced the same difficulty.

Now comes Reginald L. S. Doggett, of East Orange, N. J., with a holder so arranged that it receives the original package containing the paint or varnish. The package rests on a shoulder formed some inches above the bottom. A wide-mouthed chute or spout leads into this space, which constitutes a receiving well for the wipings from the brush. This spout has at its upper end a wiping edge so far above the edge of the holder that the wipings can not flow back into the original container.

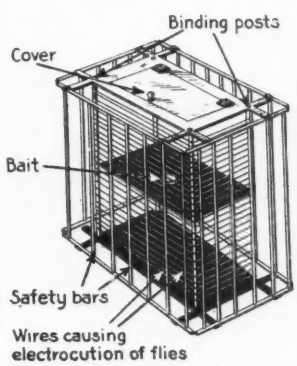
The brush-wipings are collected at the bottom in a well that may be cleaned

Electrocuting Flies—the Newest Way of Swatting 'Em

HERE is a little device which should be installed in every home. It is a little trap made of wire and charged with current from any lighting socket. The amount of current used in killing a fly is infinitesimal—not enough to cause the slightest discomfort to a human being. When the machine is not actually engaged in electrocuting flies no current whatsoever is used. Hence the operating expense should not be much over ten cents a year.

Raw meat or sugary cake is used as bait. But the flies cannot reach it without first stepping on the "live" portion of the trap. This causes a momentary short circuit, keeling over Mr. Fly.

In case the trap is to be used at night for mosquitoes, an inside light is provided which attracts the pests.



The flies that enter this trap will be much shocked

The Self-Sacrificing Engineers of the Army

IS engineering work in the European war dangerous? This question is answered by Major-General Charles A. Clement, U. S. A., who has returned to the United States from the front. He says that the engineering work back of the salvage dumps is not extremely perilous, but if the engineer is called on to lay out a line of front line trenches, the minimum loss of lives is one hundred and fifty per cent.

"In other words," he declares, "if twenty men ordered to map out a trench go over the ground with white tape so that it can be seen at night, thirty of them will be killed before the twenty lay the work out. In credit to the engineer, be it said that there are two men to go over for every man that falls. The airplane only has them beaten fifteen per cent; one hundred and sixty-five per cent of them (the aviators) die. Airplane losses seem very small as they appear in the papers, but there are ten men on the ground for one in the air. Taking the loss of those in the air, it is one hundred and sixty-five per cent of those that first go up." The civilian should understand that the high percentage of losses is due to the reinforcement of the men originally assigned to any duty though it seems to be an incorrect statement.

Must a Crew Row Together?

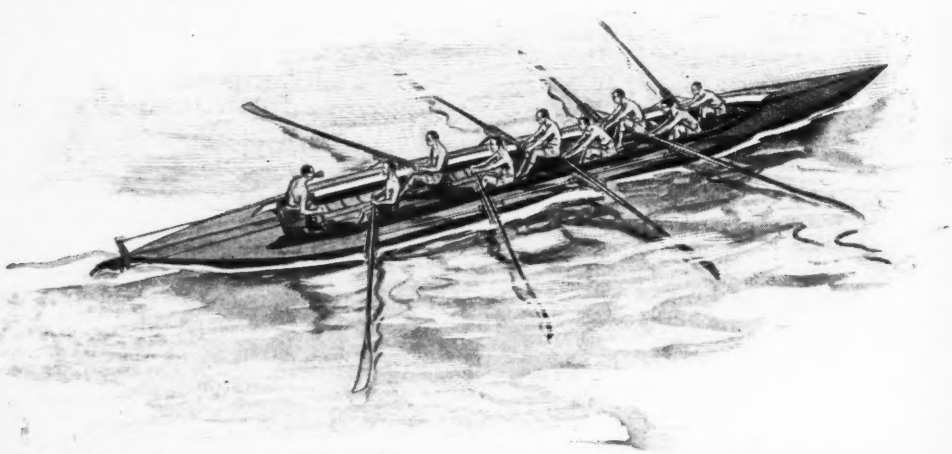
An engineer proposes a new method of racing which is based on a new principle

By Marius C. Krarup

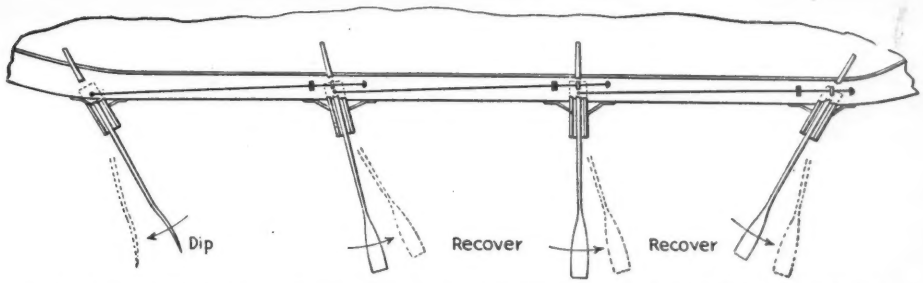
IN ROWING a boat, the error of jerky power application which oarsmen are trying to correct is counted indispensable in the main scheme of the movement but a fault to be corrected in its details. All the oars pull together and give the boat a strong push ahead during about one-half of the power stroke, and the speed gained dies down toward the end of the stroke and while the oars are taken back through the air. Great swiftness in getting back is attempted but the musculature of man is against it, even though sliding seats are used. The waste is the same as in swimming and for the same reason. The resistance at double speed is quadrupled. The loss is so great that any boat crew that can do away with it will have an easy victory over competitors who adhere to the traditional methods. There are difficulties but they do not look insurmountable. The outrigger shell may have to go, having only a slight weight-reduction to recommend it over the more practical boat with beam enough to admit of staggering the oarsmen's seats. For a given length, the deeper displacement of the outrigger is perhaps even less favorable for speed than the skimming-dish displacement of a broader structure, total weights with the crews on board differing but a small percentage. Seats can also be spaced five inches farther apart. By such staggering and spacing each man could be somewhat behind with his stroke, following the man in front without hitting him in the back at regular intervals.

The overcoming of the seating difficulty would even bring the sport back nearer to life and open up the rougher waters, where most of the pleasure is found.

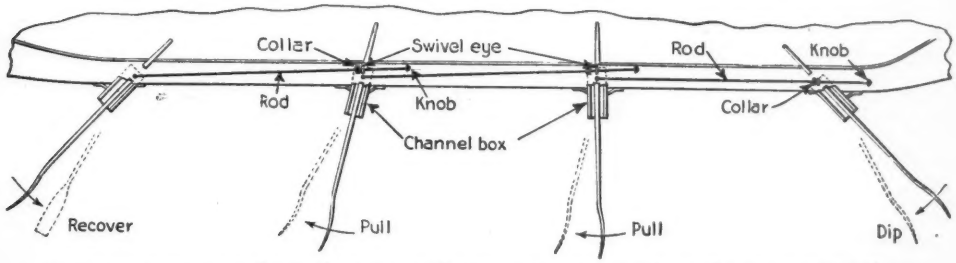
But to train a crew to row out of time on such a schedule that the stroke-oar and No. 7 are through with their power strokes just when Nos. 1 and 2 begin theirs and while 3-4 and 5-6 are at regular intermediate stages of theirs, is a more formidable undertaking than to train them to keep time with precision. Probably it cannot be done without auxiliary apparatus, and here the traditions are again in the way. Every oarsman comes to love the hip—dop, the slide and slam in the oarlocks as a criterion of skillful work. Would he consent to a change of the simple tune, a quickening of the cadence, for a 30 per cent. gain in efficiency? This would involve the re-



This picture gives an idea of the appearance of a racing shell with the crew rowing in accordance with the out-of-time plan, proposed and fully described in Mr. Krarup's article



This picture and the one underneath represent two extreme positions of the oars on the starboard side of the racing shell. Oarlocks are channel-boxes pivoted to turn horizontally



In the upper position the stroke oar is at the beginning of the pull, in the one underneath, recovering after the completed pull. The knobs limit the variations of the angles of the oars

modeling of the ordinary oar-locks.

Supposing the object was to compel the keeping of time, it could be done by arranging oarlocks as shown in the pictures at the top. Each lock is a channel-box about 8 inches long pivoted at the middle so that it will turn horizontally. Under the inner end of each box there is a pin with a knob and the pins are connected from box to box by rods, free to turn on the pins. The boxes are broad enough to permit feathering. Their bottoms may be arched, as a flat bottom would interfere with up and down maneuvering of the oar in rough water. It might be an advantage to have the locks in a straight line and get away from the irrational difference in the lengths of the oars, as may be done by outrigging all the locks somewhat: 3-4 least, 1-2 and 5-6 more and 7-8 most.

It is evident that the rods would make the oars on one side turn in unison. No one on the port side could be out of time unless all of them were, but freedom for shortened stroke on either side remains; also for reversing.

By pulling his oar as far as the knobs on the rod will let it go each man can keep his place in the out-of-time schedule. Some knobs limit the variations of the angles of the oars in one direction, other knobs in the other direction. Within the limits each oar is free and training is required to make each man maintain just the angle desired, but there should be little difficulty in accomplishing this result with the auxiliary locks suggested. The plan does not work out, however, with crews of less than six, and is best for eight.

With this system the crew can row in time if that is desired. To row out of time the oars can be parallel and at right angles with the boat for the start. The stroke oar begins and the knobs successively remind numbers 6, 4 and 2 when they must start. Thereafter the knobs are not felt except slightly at the beginning and the finish of each stroke. Otherwise only when the proper cadence is broken.

Oar No. 7 keeps time with the stroke oar, as usual, and 5 with 6 and 3 with 4 and 1 with 2, besides having the knobs for guidance. The knobs must be so far apart as to permit the two extreme positions shown in the diagrams. The seats must be so far apart that these positions can be taken without clash of oars, inboard or outboard. If the knobs are placed a little too close together, there will be a slight sacrifice either in the

continuity of the pull or in the length of the stroke, according to the option of the crew.

The gain over the keeping-time plan would with equal training amount to 33 per cent in power economy, more or less, and this would mean a 15 per cent increase in maximum speed, as the square root of 1.33 is 1.15.

The speed gain is not as great as the gain in power efficiency, and this argues for endeavoring to reduce the resistance against propulsion by all means, even before striving for continuity of the power.

A good hydroplane action, which reduces resistance greatly, depends, however, much on steadiness of the speed, and thus in one instance continuity of power and reduction of resistance are bound together. A boat rowed fast on the out-of-time plan may, if properly designed for this purpose, show a surprising amount of hydroplane action.

But after all has been said about improving rowing, if somebody suggests that the whole is a wasteful proceeding handicapped by the reciprocation and possible clash of oars, and that better results could be had by arranging to hitch up the human motors, be their number 1, 2, 4, 6, or 8, to a continuous rotating pull on one or more screw propellers, it may be hard to refute such a contention. A propeller screw operated by human power could easily be arranged to be hoisted if the water were too shallow.

Perhaps the world has rowed long enough and is waiting for a new scheme to take its place.

The Ford Delivery Wagon Can Be Used for Sunday Outings

"WHAT are you going to do Sunday afternoon?"

"I intend to take the family to my brother's farm."

"Why, that is at least sixty miles from here. How do you expect to get there and back in one afternoon?"

"Nothing simpler, in my little Ford."

"But—I did not know you had two machines!"

"I haven't!"

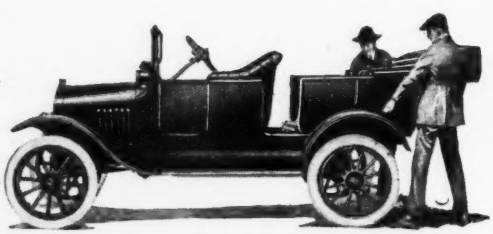
"Well, you surely aren't going to take your family in—"

"My delivery truck, you mean? Not much! Come on and I'll show you."

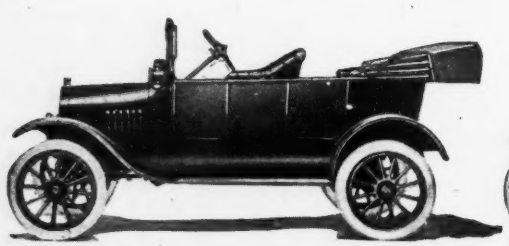
The two men go out to the garage and push out the Ford delivery wagon. In a few minutes it is changed into a neat five-seated passenger car which nobody would have suspected of being anything but that. Can so much be said for the grocer's horse that hauls the family surrey on a Sunday?

The combination device consists of a boxlike body with hinged sideboards which can be folded up flat and inserted beneath the floor of the ordinary Ford touring car. The tonneau is hinged to the front seat and to the rear wheel fenders so that it may be slid off toward the rear. The box body is then unfolded and set up in place of the tonneau to form a delivery wagon with a capacity of four or five hundred pounds.

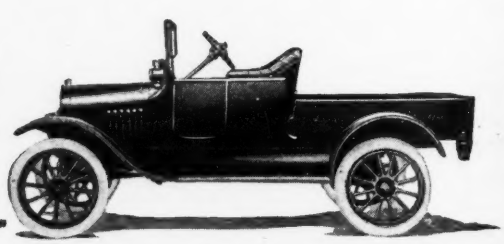
This car combines business with pleasure and fills a long-felt want.



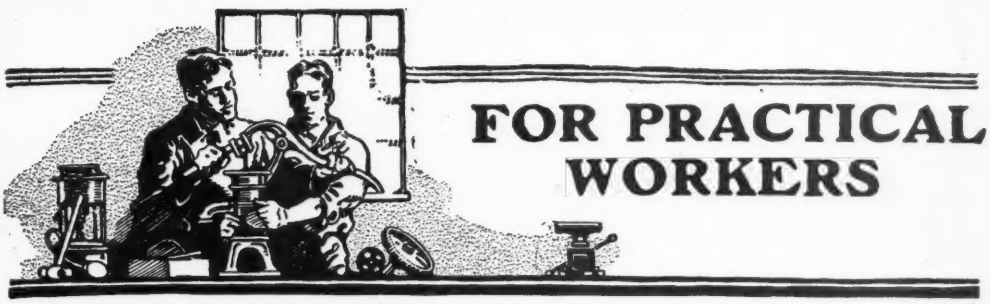
Sliding off to the rear the tonneau which is hinged to front seat and rear wheel fenders



The wagon becomes a pleasure car. The delivery body is stowed beneath the floor



The car transformed into a regular delivery wagon, ready to carry goods up to 500 pounds



FOR PRACTICAL WORKERS

A Clip to Hold the Regulation Campaign Hat on the Head

THE regulation campaign hat must be kept on the head at all times during active service, and for this reason a chin strap is attached to each hat. This strap is not easily adjusted, so that the hat may be worn as an ordinary piece of headgear while the wearer is on a furlough or taking a trip to town. To remedy this one soldier attached clips made of blued steel, as shown, which hook over the cord bands and pass through the hat rim where the chin strap is attached. The illustration clearly shows how it is made and attached to the hat.—DUDLEY HESS.

A reliable cord clip for the soldier's chin strap

Using a Breast Drill to Coil Wire and for a Grinder

AS a mechanical expedient, in the absence of a lathe, an ordinary breast drill, secured horizontally to a table, and manually operated, may be employed as a highly useful substitute for a lathe; especially for such light work as winding springs or spool magnets, or for knife or tool sharpening and polishing operations, as well as for small turning jobs.

The preferred manner of securing the breast drill to the edge of a table is by a hand screw or clamp, which grips the bearing section of the breast drill frame to the table top (the clamp shown in the illustration is a ten-cent article, but is perfectly adequate for the purpose).

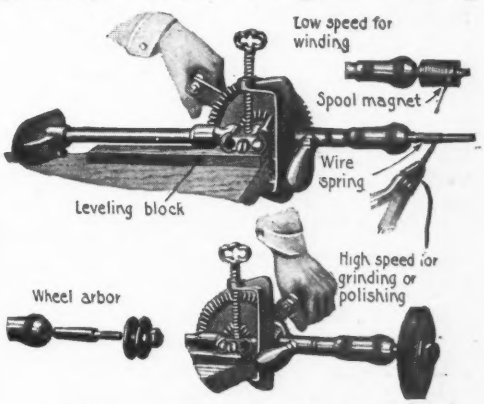
A thin block of soft wood, which is interposed between the underside of the drill frame and the table-top, serves to level the breast drill, and also acts as a protection to the table.

To wind wire springs, a mandrel formed from a large wire nail, or a piece of round rod, is gripped in the drill chuck, and the wire to be wound is then guided and held taut in the usual way with pliers by the spring maker, while the breast drill handle is turned by a helper. The same means can be employed in winding a magnet.

In most winding operations the slow speed gears of the breast drill should be used.

For knife sharpening, grinding, and polishing operations, the high-speed gears are best.

An inexpensive wheel arbor, suitable for securely holding emery or corundum grinding wheels, or buffing and brushing wheels, comprises a shouldered spindle, the reduced and threaded portion of which fits the center holes in the various wheels.



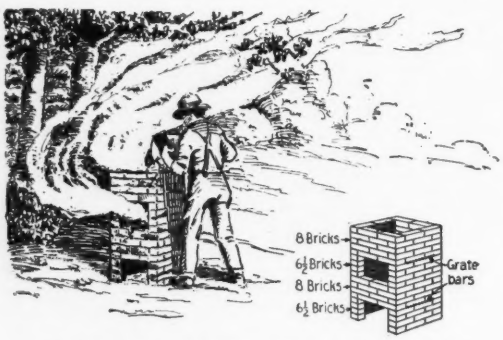
Positions of an ordinary breast drill for use in grinding or coil wire winding

Helping Out the Farmer—Prize Contest

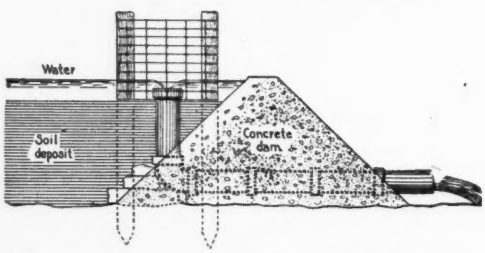
Tell the readers of the Popular Science Monthly about the simple, helpful devices you have invented for your own use, and try to win a cash prize

The pictures on this page illustrate the type of subject that can be discussed in articles submitted in the P. S. M.'s "Helping Out the Farmer" contest. Study them and send in your ideas

A GOOD farmer is a good mechanic. He has to be if he is to run a traction engine efficiently, chop wood by power, drain bottom land economically, and perform the thousand-and-one duties of the farmer with as little effort as possible. The difficulty of obtaining farm labor and the constantly widening use of machinery have made it more and more imperative to exercise ingenuity. We are convinced that the best inventive talent is to be found on the farm. Because it must express itself with the aid of simple tools and cheap material, we want to know more about it. We feel sure that among the thousands and thousands of farmers who have made farm-work easier for themselves, there must be many who have made simple machines or improved on old methods in ways that ought to be more thoroughly known.



Refuse and garbage are easily burned in this homemade incinerator built of bricks



To prevent the soil from being washed away in a low place this concrete dam was built

And so the POPULAR SCIENCE MONTHLY will conduct a Farmers' Labor-Saving Contest. Prizes ranging in amount from thirty-five dollars down are to be awarded in accordance with the rules given herewith. Some of the devices which will be described may be of sufficient commercial merit to justify their being patented.

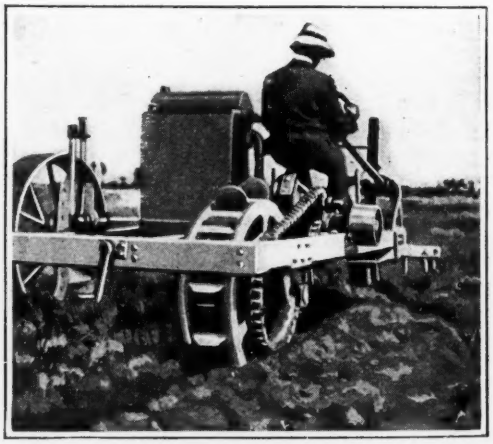
Rules Governing the Contest

(1) The device offered for consideration in this contest for practical farmers must be labor-saving in character. It must therefore be a machine or an arrangement of buildings, or a plan for a single building. A machine reduces muscular effort, and so can a well-worked-out plan.

(2) Architectural drawings of farm buildings, etc., which merely cheapen construction without enabling a farmer to reduce his muscular effort, are not eligible.

(3) The labor-saving device offered for consideration must be commercially new. In other words, it must not be purchasable in the open market.

(4) The device submitted must be of such character

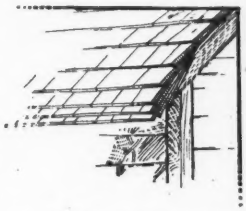


A tractor having wheel lugs that automatically enter and leave the earth vertically

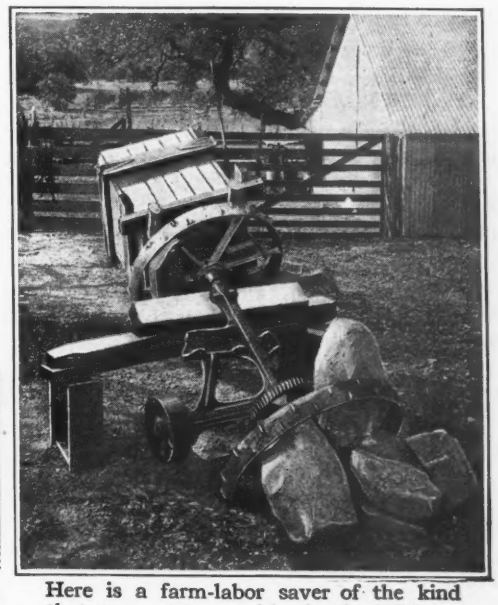
that it can easily be made by any farmer with the tools to be found on the average farm.

(5) Contestants are not limited in the number of devices which they may submit. But only one device can win the first prize, only one the second, etc. The contest is open to everybody.

(6) The labor-saving device submitted must be clearly shown in one or more views. The drawings need not be made by a skilled draftsman. It is sufficient that they should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on bristol board. The views should be sufficient in number to set forth the construction and general arrangement of the parts clearly. The contestant's name and address should appear on each sheet of drawings.

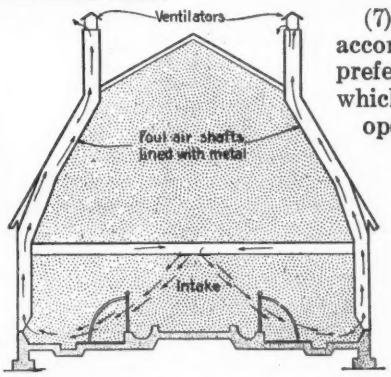


Bunching the shingles at the eaves so as to make an artistic effect

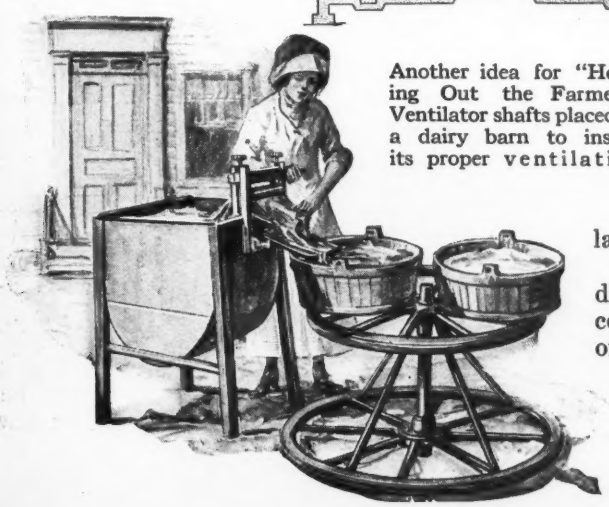


Here is a farm-labor saver of the kind that we want to consider in the "Helping Out the Farmer" contest. It's a concrete mixer made of parts of an old mowing machine and driven by the farm engine

Don't forget the farmer's wife in the "Helping Out the Farmer" contest. Wouldn't she like to use these two old cart or buggy wheels, as shown below, made into a revolving stand for the laundry? Perhaps you can think of something equally simple and practical



Another idea for "Helping Out the Farmer": Ventilator shafts placed in a dairy barn to insure its proper ventilation



(7) The drawings must be accompanied by a description, preferably typewritten, in which the construction and operation of the device are clearly given. It must be written on one side of the paper only, and it should not be more than five hundred words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(8) The drawings and descriptions entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 P.M. on August 15, 1918.

(9) A first prize of thirty-five dollars will be awarded to the contestant who, in the opinion of the judges, (the Editors of the POPULAR SCIENCE MONTHLY), has produced the simplest and most desirable labor-saving device.

A second prize of twenty

dollars will be paid to the contestant who submits a description of a device next in order of merit.

A third prize of ten dollars will be paid to the contestant who submits the next best, in order of merit.

(10) The Editor of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious devices which do not win a prize. The regular space rates will be paid to the contestants who submitted the drawings and descriptions of devices thus selected.

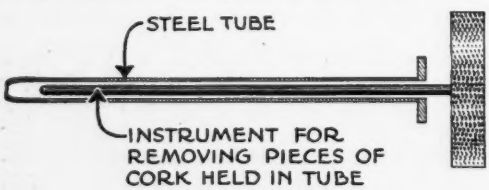
(11) Each contestant retains full property rights in the invention that he submits. The only restriction is that imposed by Rule 10.

(12) Contestants are requested to keep, for their own use, copies of their drawings and descriptions. The POPULAR SCIENCE MONTHLY cannot undertake to return material which has been entered but which does not win a prize, or is not accepted for publication in accordance with Rule 10.

(13) Address your drawings and specifications to the Farm Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York, N. Y.

Making a Tool for Cutting Holes in Cork

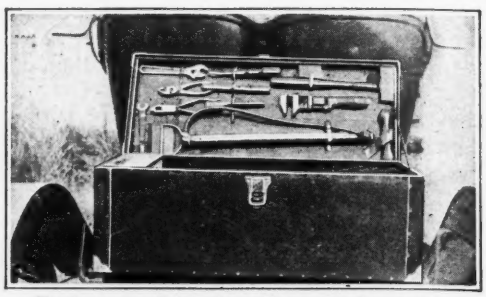
THE accompanying illustration shows a very satisfactory tool for boring into cork. It may be constructed easily from a steel tube of the right size, sharpened at one end. The cutting end may be sharpened frequently by rubbing it on an emery board, made by fastening a



piece of emery cloth to a suitable block of wood. The tool should be pressed into the cork with a rotary motion of the hand. The part of the cork that has been cut can be forced out with a blunt instrument, as shown. It must have a smaller diameter than that of the tool center. Every hole that is made in a cork should be smoothed out with a rat-tail file.

Combined Tool Case and Trunk for the Automobile

A VERY serviceable combination case and trunk for the automobile can be made of veneer boards covered with light sheet steel. In size it can be adapted to any automobile, but the one shown is 1 ft.



Tool case and trunk on the rear of an automobile, showing arrangement of the tools

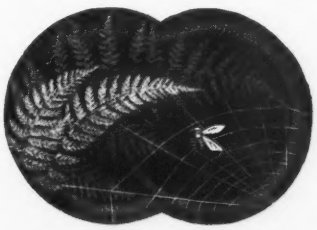
wide, 1 ft. deep and 30 in. long. The corners are finished with regular trunk hardware and the whole is painted to match the color of the automobile. The inside of the cover is arranged to hold the tools. These are held in place with ordinary spiral screen-door springs fastened down at proper intervals with sheet-iron straps, leaving loops through which the tools are inserted. The tension of the spring holds the tools firmly in place, but still they can be easily withdrawn for use. In the lower part of the trunk at the left are two compartments, each just large enough to hold a spare inner tube.

A small wood-bottomed box is made to fit snugly over the tube compartments to hold small parts. The pump is held in place by inserting the handle under a narrow sheet-iron strap while the foot is held by a spring-actuated pin that slips into a small hole drilled for the purpose. The hammer head is inserted into a sort of open-sided box made of sheet iron and the handle is slipped under a piece of clock spring. These arrangements have proved very satisfactory after several months' use. The whole trunk was constructed in a home shop with ordinary tools. A vise and two flat pieces of steel ½ in. by 2 in. by 18 in. were used as a brake for bending the steel sheets for covering the trunk. The trunk or case presents a very neat appearance on the rear of an automobile.—N. O. MOORE.

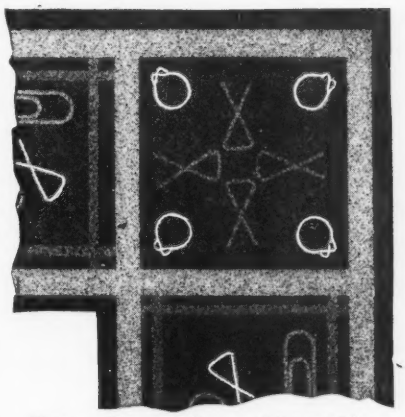
Making Decorations by the Spatter-Work Method

ALTHOUGH spotted work is by no means new, still few persons know what it is, and for what it can be used. Spotted work is an art that every person can quickly master. In fact it is extremely easy and demands no artistic ability.

Decorative work can be made on boxes as well as on paper. On boxes it is doubly effective when both the top and the sides are ornamented. When a dark-brown stain is used, the design on the box will resemble poker work. Small center pieces, table covers, and napkins may also be made if indelible inks are obtainable.

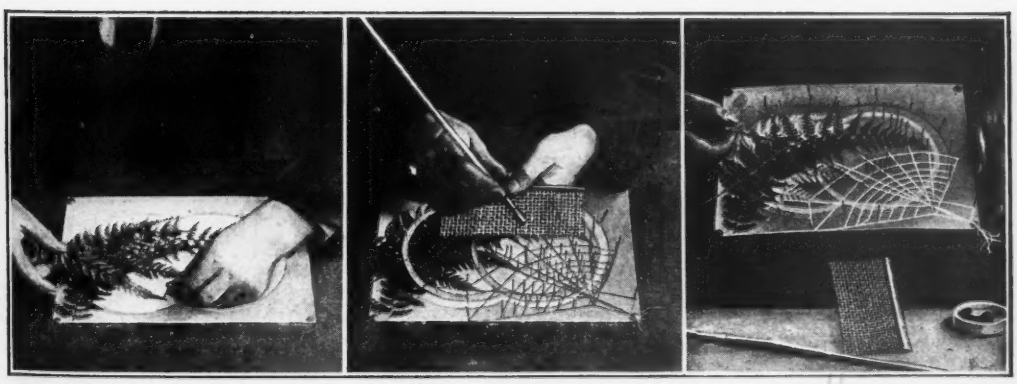


An attractive decoration made from fern leaves



Paper clips can be used for making border decorations on a box or frame

Dried leaves are usually used, preferably ferns and other feathered leaves. To form artistic designs these are pinned flush with the paper, when paper is taken. To heighten the effect, a butterfly or a bee may be added. These must be cut accurately from paper and then pinned on. If a cobweb is added, the finished design will be very effective. In order to make the web, take numerous pins and a long, thin cord, stick the pins on the paper and place the cord tightly about them, until a general resemblance to a cobweb can be noticed. Now the paper is ready to receive the ink. The best results are obtained from a wire screen 3 in. wide and 6 in. long, having a mesh of about ¼ in. A short, stout brush similar to those used for stenciling must be procured. This is dipped in a not too fluid ink and gently brushed over the screen. The screen should not be held over 6 in. above the design. Small spots will soon appear over the entire surface of the paper. When sufficient ink has been used (that is when the ink has been evenly distributed over the paper), take off the topmost leaf, which will now be white throughout. Resume brushing. Take off another leaf and brush again. By this method, the leaf taken off first will be the darkest, while the one removed last will be lightest of all. Of course there will be many *gradations* between these two, making a pleasing contrast. If a bee, butterfly or cobweb were added to the design, it should be removed when the sprinkling is half finished so as to be partly covered when the design is completed.



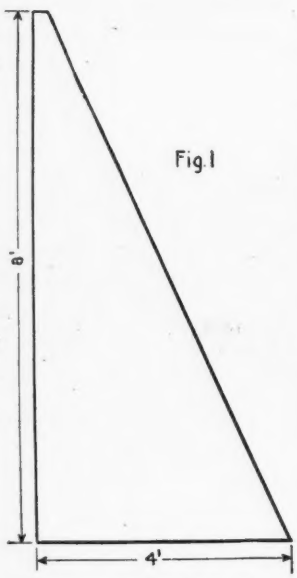
Different stages in placing the leaves, spattering the work with the use of a screen and laying on card for the design of a cobweb to form an effective combination with the leaves

Open Canoe Cruising

IV.—A canoe-cruising outfit for the one-night and permanent stand. Choice of tents, cooking equipment, clothing, food, tableware and beds

By E. T. Keyser

CANOE-CRUISING outfits fall into two classes, the light, compact equipment for the week-end encampment or the extended cruise where one-night stands are the rule and where every bit of duffle must be unpacked and arranged at the close of each day's journey, and the more comfortable and elaborate layout of the permanent vocation camp from which the canoeist makes short day trips.



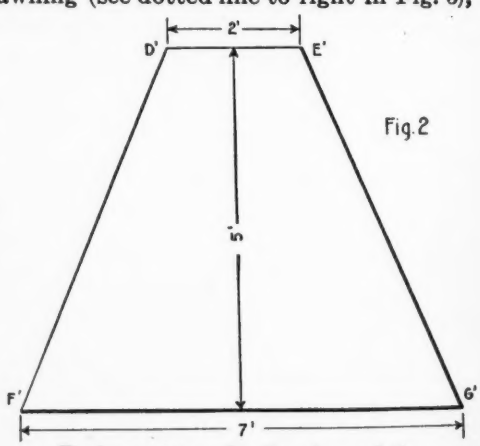
Pattern for one-half of each of the four sides

When going light and pitching the tent every day or two, the waterproof pyramid tent with a projecting awning door is the best type to carry. Such a tent, 7 by 7 ft. on the ground and 7 ft. high, will accommodate two persons comfortably and may be easily and cheaply built by the canoeist. In Fig. 1 is shown a pattern of one-half of each of the four sides. It would be a right-angled triangle of 8 ft. altitude and 4 ft. base, but for the fact that the upper angle is clipped, leaving 2 in. between the side and hypothenuse.

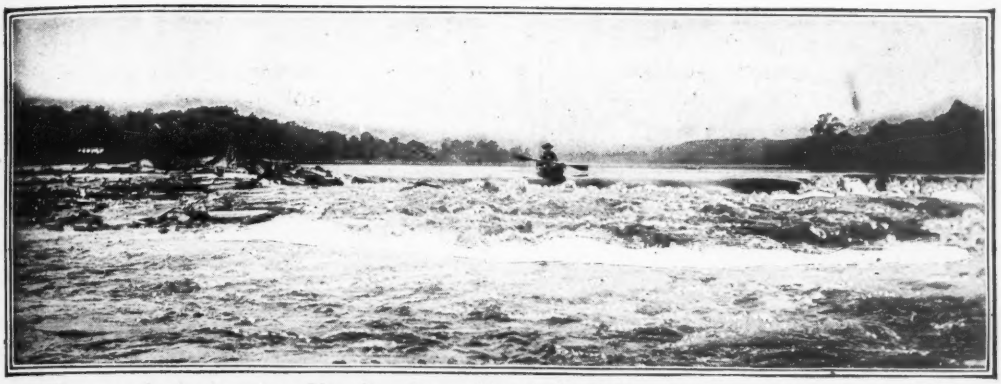
Cut eight of these sections from unbleached muslin and join them in pairs along the sides, overlapping with a 2-in. seam. Then join the sections so made to each other along the hypothenuse of each, lapping 2 in. Before joining the last two sections, lay the tent out flat and paint it with gasoline into which has been shaved as much paraffin as the gasoline will dissolve. Paint both sides of the material and then hang it up to dry. When the gasoline has evaporated, the paraffin fills the pores of the muslin and it is made waterproof.

Turn up a 2-in. hem around bottom of tent and sew up the remaining open side. Then sew all around the bottom edge the sides of a heavy brown canvas floor cloth. Then cut out and sew together the awning door as in Fig. 2. This is 2 ft. wide across top, 7 ft. wide at bottom, and 5 ft. high. Lay the tent on the ground and peg it out and stretch one of the sides taut and fair. Then mark out the position of the door *A*, *B*, *C* (Fig. 3). This door, shown by the broken lines, is 5 ft. high, of triangular form with a 4-ft. 6-in. base which is 6 in. above floor of tent. This leaves a sill to keep out rain and insects.

Sew door as in Fig. 2 to the tent, letting *D'* coincide with *D*, *E'* with *E*, *F'* with *F* and *G'* with *G*. This is to be heavily sewed from *D* to *E* and fastened from *D* to *F* and from *E* to *G* by small snap hooks or tapes as desired. This door will be found very convenient. It may be rolled up and held in place with tapes placed at *D* and *E* or, by setting loops at *B* and *C*, may be held up as an awning (see dotted line to right in Fig. 3), allowing tent door to remain open during a sultry shower and shading the interior of the tent on a sunny day.



Design pattern for the door of the tent which is used also for a shade



The canoe in fresh water: Shooting the rapids of the Delaware River, where the canoeist must keep his wits about him and watch out for submerged rocks and treacherous waves

An ideal outfit for the one-night stand: A pyramid tent, a folding chair, and a collapsible table

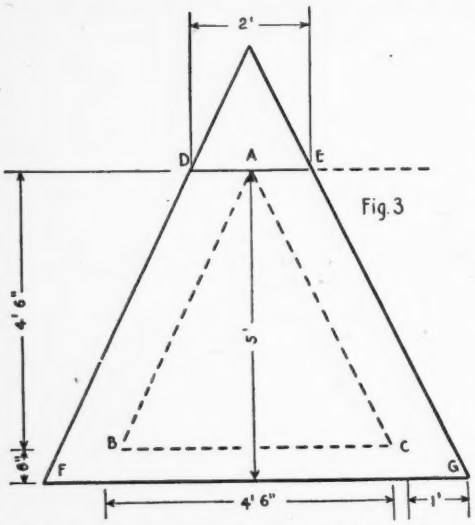
The permanent camp. A 7 x 7 wall tent with projecting fly, under which the table is set

Canoeists making for the beach of a Hudson River encampment. A complete equipment for two is stowed below the gunwales

A boy of thirteen can carry the pyramid tent and the clothing bag without the least difficulty

The projecting fly of the wall tent keeps off sun and rain and makes the coolest place in camp

A single pole, 7 ft. long and ferrule-jointed at the center, supports the tent, a ¼-in. brass pin is set into the end of the pole and passes through a wooden bull's-eye sewed into the apex of the tent. A rope with a knot in the lower end may be passed through the bull's-eye and used to suspend the tent from the limb of a tree or from a pair of poles cut at the camp site and arranged shear fashion. The tent described will weigh but 16 lb. and when packed makes a roll 20 in. long by 10 in. diameter, which may be handled easily by a small boy. It requires but four pegs, one at each corner, placed through a loop of ¼-in. clothes line sewed to each corner of the floor cloth.

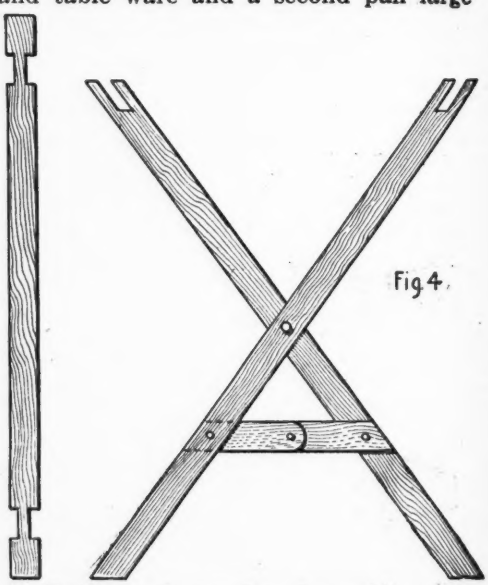


Front view of a pyramid tent, the dotted lines showing the opening cut for the doorway

For a permanent camp, there is nothing better than the regulation wall tent with a projecting fly. Such a tent, 7 ft. long, 7 ft. wide and 7 ft. high at ridge and 3 ft. at eaves, will accommodate two persons comfortably and four at a pinch. With a floor of heavy waterproof brown canvas and a 14 by 14 ft. fly it will weigh 32 lb.

An 8-oz. non-waterproof canvas is heavy enough for the tent as the fly keeps off the rain and heavy drill is correct for the fly which projects 7 ft. in front of the tent, forming an open-air kitchen and dining-room. The three poles should be ferrule-jointed and the ridge pole hinged so that all may pack in a 3½-ft. length. A rope ridge or a stake cut at the camp will serve for the fly. A few wire screw hooks, such as are made for clothes closets, set into ridge pole and end poles, will accommodate the campers' wardrobe and may be removed when taking down the tent.

The choice of camp stoves depends upon local conditions. Where drift wood is plentiful a wire refrigerator shelf laid across two logs or topping a three-sided stone fire-place allows one to obtain the maximum service from a wood fire, but where wood is scarce, a kerosene-vapor stove or even a pocket alcohol cooker will prove the better arrangement and the latter may be utilized inside the tent in rainy weather. The minimum for comfort in a cooking outfit consists of a frying-pan, coffee percolater, folding-handle saucepan with cover, and a pail for boiling water; they should all be of enamel or aluminum ware which may be left outside over night without danger of rusting. Cut off the handle from frying-pan, using a cheap little monkey wrench for a removable handle. Each person will require two plates, one cup, one soup bowl, a knife, fork and two spoons. After collecting the equipment, purchase a tin pail large enough to contain both kitchen and table ware and a second pail large enough to hold the first. If the bail of the inside pail is without a wood handle and the top has a folding ring instead of a knob, one can get a closer telescopic fit.



Trestles and cross bars for making a camp table that is compact when folded

The larger pail is simply a carrying case to prevent soot from the inside pail from soiling the outfit.

In Fig. 4 is shown the lightest and most compact type of camp table. It consists of two wood trestles, pivoted by a bolt or rivet. The upper ends of each are slotted as shown and the lower ends held rigid when open by jointed folding brass braces. The trestles are joined by two strips of wood, notched to fit the slots in trestle heads, and across these is laid a table top of two thicknesses of enameled duck sewed together with pockets between, in the same manner as the canoe cushions already described but with thin wood slats or lath inserted. The dimensions depend entirely upon whether the canoeist expects to sit upon a camp chair or a cushion when eating. The four wooden sections fold together and may be wrapped within the rolling top making a light compact bundle; the advantage of the enameled duck surface lies in its inability to absorb grease.

Camp beds are of three types—air beds, cushions and folding cots. The first is the most comfortable, but against this advantage is the drawback of weight and bulk and it must be inflated when making camp and deflated for packing. It is therefore less suitable for the light-weight outfit of the one-night camp than a less comfortable but more compact cushion bed constructed after the manner of the canoe cushions already mentioned. The folding camp cot, while rather weighty, is compact and comfortable. It cuts down tent accommodation less than a cushion bed as it permits of storage space beneath it being utilized. To counterbalance this advantage, it requires as much bedding beneath as above the sleeper and cannot be utilized to advantage in a small tent such as the pyramid already described. For a wall tent, if topped off with an air bed, it is ideal.

Two pairs of all-wool 4-lb. blankets per camper constitute a better outfit than one pair of heavier covering, as they permit of several combinations of warmth according to the conditions which may prevail. They should be either red or dark gray in color.

A soft, light-colored felt hat with a wide brim, a gray flannel shirt, light or heavy weight according to season, khaki knickerbockers with long stockings, over sleeveless undershirt and knee-length drawers, constitute a practical and comfortable dress. Soft-soled, low-cut moccasins for the canoe and a pair with stiff leather soles for ashore, a sweater coat with sleeves, and an oilskin, long cut, will complete the outfit. At least one change of shirt, knickers, hose and underwear is necessary in case of becoming soaked with rain or perspiration. These articles and the toilet outfit can be carried in a waterproof canvas duffle bag, 30 in. long and 10 in. diameter. The bag should have one handle on the side for carrying and another on the closed end so that its contents may be shaken out when wanted.

Sugar, salt, butter, lard and coffee are best carried in screw-capped preserve jars with mouths wide enough to allow the hand being inserted for cleaning. Flour, Indian meal, tea, cocoa, baking powder, washing powder, rice, etc., should be carried in air-tight tins, such as some tobaccos come in. Home-made muslin bags with draw-string tops are convenient containers for potatoes and bread, and all these individual containers are in turn to be carried either in tin cracker boxes or large tin pails. The kerosene stove is carried in a small pail of its own which has also accommodations for a bottle of alcohol for priming and for a couple of quart tin canteens for kerosene. The water is best carried in a canvas water-bottle which occupies no space when empty and which when full does not threaten the planking of the canoe in rough weather. If the type with an attached funnel cannot be obtained, be sure to carry a tin funnel along for filling the jug; it will save much time and trouble.

It will be observed that every article has been provided with a waterproof container or covering. The blankets with the air bed or cushion are laid upon the floor of the tent before the latter is struck. Then the tent is folded with the waterproof flooring outside and the whole made up into a waterproof roll which is strapped or securely roped. The tent may be pitched in a pouring rain and the bedding remain dry and one may start out on a cruise in a downpour and arrive in camp with everything dry—a change of clothing, a rub-down for the skipper and

crew, and every one is ready for the evening meal despite weather conditions.

Keeping a camp sanitary is the easiest thing in the world if every bit of refuse is buried immediately or burned in the fire before the flies congregate. As most of the insects which infest the average tent are attracted by lighting the canvas abode at night, this should never be permitted except when absolutely necessary; the tent, moreover, is usually much lighter at night than one would suppose possible. A mosquito netting pinned around the entrance will do much to keep out flies and mosquitoes. At the same time a lantern should always be included in the outfit. It may not be needed once in a dozen trips but when it is wanted it will be needed badly. I have been all down the line with electric, carbide and folding candle lanterns and have wound up just where I started, with the old-fashioned tubular lantern. It is bulky, smelly and smoky, but it is there when needed, which is something which cannot always be said of batteries and carbide under camping conditions. Of course, for trips far afield where kerosene cannot be obtained, the folding candle lantern is the only logical equipment.

Much of the outfit described in this series may be made by the canoeist himself or purchased reasonably and it is light and simple enough to furnish a splendid summer for the youngest cruiser, while at the same time it represents the process of many seasons of experience.

The End

A Simple Way to Distinguish Iron from Steel

THE repairer of machinery often has to select pieces of metal from the scrap heap to make repairs on various machines, and is at a loss to know whether the metal he has selected is iron or steel. By using the following methods, wrought iron, cast iron and mild steel are easily distinguished from each other. File a bright spot on the metal and place a drop of nitric acid on the metal and leave for a few minutes.

The spot will appear ash-gray on wrought iron, brownish-black on mild steel, and a deep black on cast iron.

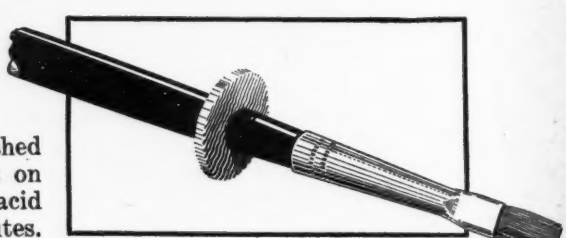
Easy Removal of Exhaust Valves from Motorcycle Engines

GREAT difficulty is often encountered in removing exhaust valves, on account of the spring. To extricate them a piece of U-shaped steel may be used with considerable ease. Turn over the engine crank until the valve is wide open, then insert the piece of steel between the tappet guide and the washer on which the spring rests. The metal piece should be long enough to exactly fit this space when the valve is fully open. Turn the engine until the cam permits the valve to close. Then the metal piece will support the spring washer. Put a screw driver in the slot in the top of the valve head, and tap it lightly until the washer is loose from the valve stem and the valve will drop to its seat. The spring is held clear of the lower end of the stem by the metal piece. It is then an easy matter to unfasten the valve stem cap and to remove the valve. —NORMAN WUNDERLICH.

A V-shaped piece to hold the spring washer

A Brush Shield Made of a Rubber Washer

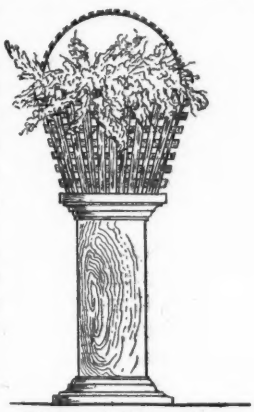
A SMALL rubber washer slipped on the handle of a small brush, as shown in the illustration, will prevent any paint from running down the brush handle and will also keep it from smearing any surface on which it may be placed when not in use. Such a washer can be cut from a piece of rubber tire that has been discarded.—JAMES M. KANE.



A washer cut from a piece of rubber tire placed on the handle of a small brush

Ornamental Fern Basket Made in Lattice Work

THIS basket is one of the prettiest fern holders made for the lawn or flower garden. It consists of a box which is smaller at the bottom than at the top and has strips nailed on it as shown. Two of the strips are bent for the handle and a number of short pieces nailed on it crosswise. The strips, which are $^3/_{16}$ in. thick and 1 in. wide, are nailed on the sides of the basket the same as lattice work.



Pedestal flower box representing a basket

The box used as a base is large enough to hold a tin pail or a flower pot which in turn holds the earth for the growing plant. When the stems and leaves grow all over the top of the basket and covers it well it produces the appearance of a large basket of flowers. If it is well painted it will stand any kind of weather. The pedestal consists of four pieces of lumber nailed together in box form. However, it is not necessary to have a pedestal as the basket can be set on the porch or the stump of a convenient old tree.—CHARLES SCHADEL.

Perforating Paper Sheets with Sharpened Cog Points

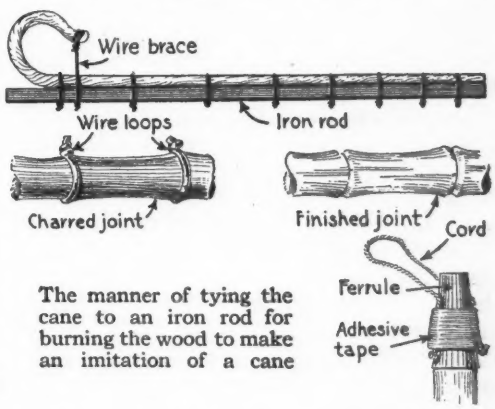
ONE day in the office I needed to perforate a sheet of paper, and as I had no special device for the purpose, I looked for a way out of my difficulty. By taking an old common clock cog wheel, which was in the bric-à-brac on the desk, sharpening the points of the cogs a little with a file, and then inserting a pencil through the cog wheel and rolling it over the paper, the sheet was perfectly perforated.

As a matter of fact the device works so well and has proved so valuable and labor-saving to me that I am going to keep it for permanent use in my office.—H. K. CAPPS.

Finishing a Rough Stick To Imitate Burnt Bamboo

TO prevent a rough stick from warping it was wired to a square iron bar and run through a gas flame to give it a burnt finish. Upon removing the stick from the rod, the surfaces under the wire loops were found to be little fire-worn and as they were higher than the burnt surfaces they suggested the joint divisions of a bamboo rod and the stick was finished for one.

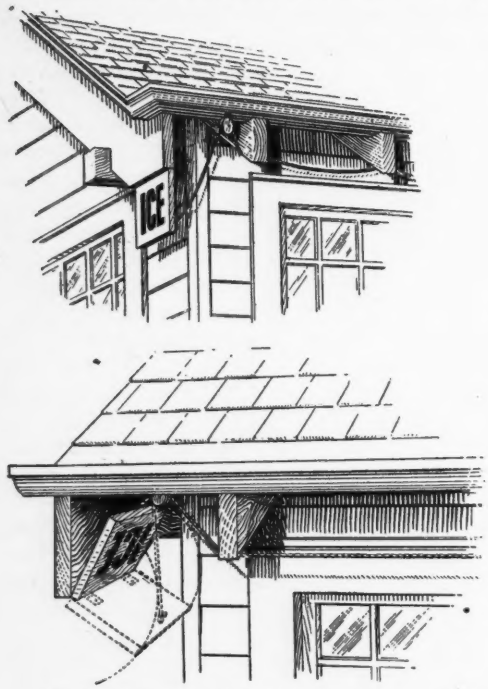
If the stick is perfectly seasoned it should not warp in the flame. If at all green it should be wired to some material that will not bend. Use as many heavy wire loops as desired for joints in the stick. A curved handle will need a wire bridle to prevent the curve from uncurling. Use a torch or gas flame to do the burning, allowing the flame to dwell longer on the portions requiring depth of color. If the stick is fastened to a rod, it will be necessary to remove it to finish the side that rests against the rod. Remove charred surfaces, model for form and draw the color with sandpaper, glass or a file, then smooth with fine sandpaper. Rub in a little oil and rub clean, then apply several coats of pale shellac. Rub down each coat with sandpaper and the last coat with oil and shellac for a dull finish. If a high polish is desired use varnish. To hang up the stick without smudging the surface, knot a string and fasten it on the ferrule with adhesive tape as shown. The finishing of a stick in this way permits of so much originality both as to color and shape as to render the completed cane well worth while.—JAMES M. KANE.



The manner of tying the cane to an iron rod for burning the wood to make an imitation of a cane

Novel Arrangement for an Iceman's Sign

IT IS the custom in some cities for the local ice companies to furnish their patrons with pasteboard placards to be



An ice sign hinged to the edge of a verge board which is worked by a cord

displayed in a conspicuous place on or near the house, where it may be seen from the street, on those days when a supply of ice is required for the refrigerator. Obviously this is to save time for the iceman and to spare him the inconvenience of stopping when he is not needed. Aside from the shock to one's esthetic taste of having the front of your residence decorated with such a sign, there is always the possibility of its being misplaced or blown away, which means extra steps to post it and return it again to its place of safe-keeping.

An ingenious friend of mine has devised a simple means of overcoming some of these little difficulties. To the lower edge of the verge-board which overhangs the front corner of his house he has hinged a ½-in. board, to the front face of which he has securely tacked the paper sign. At the bottom of the board in the center is attached a strong cord which runs up through a small pulley above and back along the rafters under the eaves until it reaches a point within the screen-porch directly alongside the refrigerator. When no ice is desired, the sign is drawn up behind the verge-board and completely hidden from view. Of course the verge is not the only place where the sign may be attached. A beam conveniently situated, a gutter, or even the limb of a tree might serve equally as well.—HUNTINGTON BAKER.

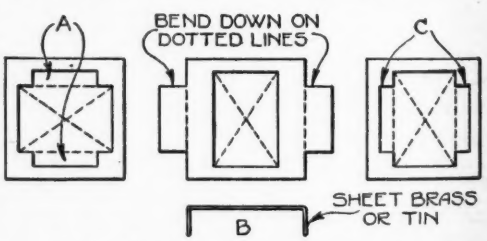
A Method of Loosening Tight Nuts or Bolts

IF the nut or bolt is rusted so tightly that no amount of manual energy will loosen it, then chloroform it. A few drops of this drug, placed on the nut or bolt, so that it can soak into the threads, will loosen them so that the nut may be turned quite easily. Kerosene, used in a similar manner, will give the same results, but requires much more time to cut the rust.—PETER J. M. CLUTE.

Masking Device for a View Finder on a Camera

AMATEUR photographers, taking a picture, when locating the person to be taken in the view finder, often include the view in the space *A*, and when the negative is developed find that part of the picture is missing. The photographer has forgotten that only the view indicated within the dotted lines will show in the picture.

The masking device shown in *B* can be clamped over the view finder, thereby blocking out the not-wanted space *A*.



A view finder mask to be clamped over the unused open spaces on the cross screen

When taking vertical pictures, the masking device may be clamped so as to block out the view *C*.—FRANK HARAZIM.

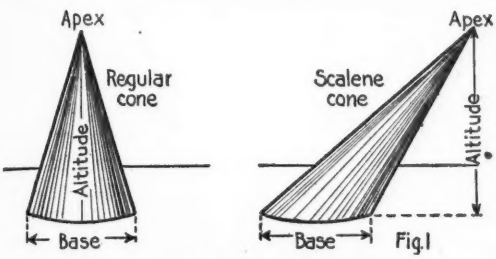
Simple Designs for Sheet Metal Working

XIV.—Radial line development of patterns for pipe fittings that are parts of scalene cones

By Arthur F. Payne

Director of Vocational Education, Johnstown, Pa.

THE problem presented in this issue will be the last in which "radial lines" are used as a means of developing the patterns. In the March, 1918, issue radial lines were used for the first time in this series. All of the other "radial line" developments have been parts of "regular cones," that is, cones in which all of the sides are equal, as shown in Fig. 1. The problems in this



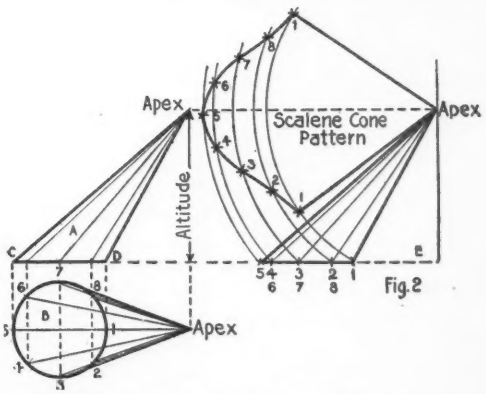
A regular cone with all sides equal and a scalene cone without equal sides

issue are parts of scalene cones, that is, cones in which the sides are not equal.

There are two distinct methods of developing the patterns for scalene cones, the simplest is by the use of radial lines, the other is by "triangulation." The triangulation method will be started in the next issue.

In Fig. 2 is shown the method of developing a pattern for a scalene cone by means of radial lines. First, draw the front view *A* of the cone (note where the altitude is measured in Fig. 1); second, draw the bottom *B* as shown; third, divide the bottom-view circle into eight equal parts and draw lines from these points to the apex. The pattern would be more accurate if the circle were divided into twelve or sixteen parts, but to avoid making the drawing complex only eight have been used in the illustration. Looking at the front view *A* it will be seen that the lines *C*-apex and *D*-apex are the only lines that show their true length. This is the case in all cones. It will be remembered that in recent problems the true length of the other lines was obtained by projecting them over to the side lines. In scalene cones a different method is used which is as follows: Fourth, draw the right angle *E*, then with the dividers measure the distance 1-apex on the bottom view and set off as a distance 1-*E* of the right angle *E*. In this manner measure all the other bottom-view distances, 2-apex, 3-apex, 4-apex, etc., and set off from the right angle *E* as shown. The purpose of this is to get the true lengths of these lines. It really is elementary triangulation, and is explained as follows: If two sides of a triangle are given it is very easy to get the length of the third side. In this case we have the length of one side *E*-apex obtained from the front view *A*. We next get the length of another side from the bottom view *B*. Fifth, we now draw lines from the points on the line *E* to the apex; these lines are the true lengths of the foreshortened lines in the front and the bottom views.

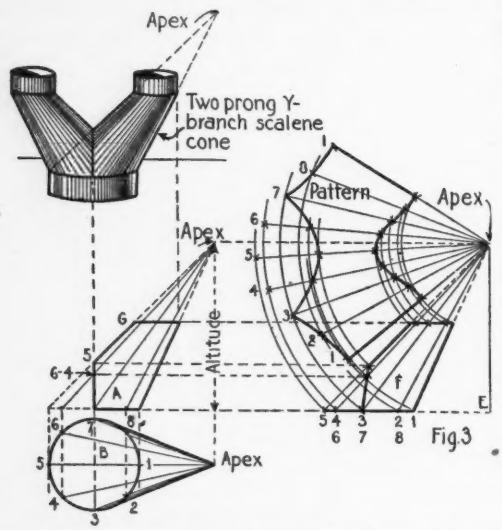
Do not be discouraged if you do not understand the foregoing explanation,



A method of developing a pattern for a scalene cone by means of radial lines

as this problem of triangulation will be thoroughly explained in the next issue. Sixth, now we can lay out our pattern. With the apex as the center, strake arcs from each of the numbered points on the

base line *E*-5. Seventh, anywhere on the arc coming from point 1 make a cross, set the dividers at the distance from point 1-2 on the bottom-view circle, set this distance off on the arc 2 and make a cross at this point. Set the same distance off from point 2 to the arc 3, and so on



A two-pronged branch consists of parts of two scalene cones made from one pattern

until you have set off the eight spaces. Connect all the crosses with a curved line and draw a straight line from both point 1 to the apex and the pattern for the scalene cone will be complete.

A practical application of the methods just described is shown in Fig. 3. The problem is to develop the pattern for a "two-pronged Y-branch." The first thing necessary is to recognize that it is part of a scalene cone, as illustrated by the dotted line in the sketch of the completed branch. Both sides of the branch are alike so that it is only necessary to make one pattern. The steps taken are exactly the same as for Fig. 2.

To develop the pattern, first, draw a front view *A* and bottom view *B*. Second, divide the bottom view circle into eight equal parts and draw lines to both apexes. Third, draw the right angle *E*, making the height equal to the altitude of the cone. Fourth, set off the distance *E*-1 equal to the distance apex-1 of the bottom view, do the same with the other distances. Fifth, now we have to locate on our true length, view *F*, the joint line where the two pieces of the branch come together at the center. This is done by projecting lines across from the front view *A* to the true length view *F*. The lines projected begin at the points where the center joint line crosses the lines 5 and 6-4, going to the apex. They end on the same lines on view *F*. Make crosses, then connect these crosses with a straight line. Sixth, project the top line *G* from the front view *A* to the true length view *F*, as shown in the drawing. Seventh, now we are ready to lay off the pattern. This is done by drawing arcs with the apex as the center from the numbered points at the base of the view *F*. Eighth, set the dividers to the distance 1-2 on the bottom view, and starting anywhere on the arc 1 set this distance from arc 1 to arc 2, etc., exactly the same as for the one in Fig. 2. In this problem it will be necessary to draw the radial lines from the points on the arcs to the apex, because we now have to locate the curve for the center joint line and for the top line of the pattern. Ninth, to locate the three points, 4, 5 and 6 for the center joint line, draw two arcs from the crosses on the center joint line of view *F*. When these arcs cross the radial lines 4-5-6 make crosses and connect them with a curve at the bottom line and the pattern is complete. Tenth, now we have to locate the points for the top line of the pattern. This is done by drawing arcs from the crosses on the top line of View *F*. Where the arcs cross the same numbered radial lines make crosses, connect the crosses with a curve and the pattern for the "two-pronged Y-branch" is complete.

In the illustration Fig. 4 is shown a more complex problem, the development of patterns for the "three-pronged branch." This problem has one new element in it; that of location of the joint line, otherwise the process of development is exactly the same as in the other problems in this issue.

The first step is to draw the bottom view *A*. Be sure and draw this view in the position as shown. This is necessary because we must have the right prong of the front view in its true elevation. The two prongs on the left (only one can be seen, the other being just back of it) are "foreshortened," that is, the top of the prong seen is slanting toward the ob-

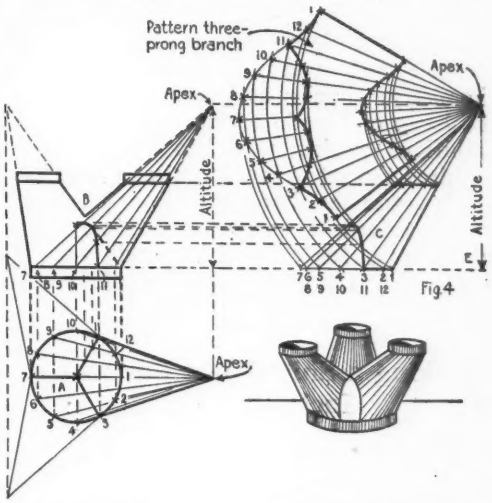
server, the one on the back is slanting away. The pattern could just as well be developed without the prongs on the left being shown, but it was thought that they would make the problem more easily understood.

The new element in this problem is the location of the joint line. This is done after the bottom view *A* and the front view *B* have been drawn by following the steps as described for the previous problem. To locate the joint line on the front view, mark with a cross the points where the joint line on the bottom view crosses the radial lines 7-8-9-10-11 going to the apex. Project lines from these points up to the front view to where they cross the same numbered radial lines going to the apex. At these points make crosses and connect them with a curved line. Note that this joint line on the front view is foreshortened, that is, point 11 is the nearest and point 7 is farthest away.

Now draw the true length view *C* as described for the previous problem. Briefly the steps taken in order are: Project the altitude over to the left from the front view. Draw the right angle *E*. Take the distance apex-1 on the bottom view and set it off as *E*-1 from the corner of the right angle. Take the distances apex-2, apex-3, apex-4, etc., and set off as *E*-2, *E*-3, *E*-4, etc., on the right angle. Draw radial lines to the apex from the points on the view *C*.

From the front view *B* joint line points, project lines across to the view *C* until they cross the like numbered radial lines. Make crosses at these points and connect them with a curve and we are ready to lay out the pattern. Lay out the bottom part first. With one point of the compasses at the apex swing the arcs from the numbered points at the base of the cone as in view *C*. Then set the compasses at the distance 1-2 on the bottom-view circle and starting anywhere on arc 1 set off this distance over on arc 2, then to arc 3, etc. From these points draw the radial lines to the apex. Now swing the arcs over from the joint line points on the view *C* and where they cross the like numbered radial lines going to the apex make a cross and connect them with a curved line at the bottom line and the pattern is developed.

Project the top line of the prong from the front view *B*. From the points where the top line crosses the radial lines swing arcs over until they cross the same numbered radial lines and make crosses at these points and connect them with a curved line and the pattern for the "three-pronged branch" is complete.



The development of a pattern for a more complex problem for a three-pronged branch

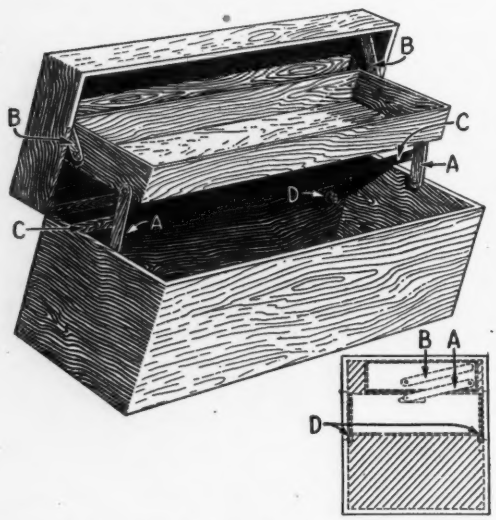
One of the numerous questions sent in by readers of this series is "how can I find the diameter of the prongs of a Y-branch when the area of all the prongs must be equal to the area of the large outlet?" The answer to this question is best given by two rules governing the circle. The first rule is to multiply the square of the diameter by .7854 and the product is the area. An illustration of the working of this rule is: we have a large outlet, the diameter of which is 9¾ in. This expressed as a decimal is 9.75 in. Square this (multiply it by itself) and we have 95.0625. Multiply this by .7854 and we get 74.662, area in square inches. Now if we have three prongs we divide this area by three which gives us 24.887. The second rule is to multiply the square root of the area by 1.12837, the product being the diameter. This will give the diameter of the three small prong outlets as follows: The square root of the area, 24.887, is 4.91215. Multiply this number by 1.12837 which gives 5.5427226955, but only use 5.54 which is accurate enough. This is about 5 $^{9}/_{16}$ in. in diameter for the small prong outlets,

the sum of the areas of which will be equal to the area of the large outlet, the diameter of which has been given as 9¾ in.

This illustration of the application of the science of mathematics to the art of sheet-metal working is only one of many opportunities that are open to the trade workers to apply the science of their trade in their daily work. The principles of chemistry, physics and mathematics are the bases of "trade science," and to the ambitious worker who has by practice acquired the art of manipulating the tools of his trade the field of trade or applied science affords a wonderfully interesting opportunity for growth that will repay the worker richly in terms of pleasure, self-development and money.

Making a Shirt-Waist Box with Inclosed Tray

MATERIAL for the box and cover should not be less than ⅝ in. thick. The tray, levers and stops are made of stock not over ⅜ in. thick. Poplar is a very good wood for this box; but any



An inclosed tray with levers to lift it when the box cover is thrown back

soft wood may be used with good results. The inside measurement of the box is 40 in. long, 18 in. wide and 16 in. deep, and the cover is the same length and width and 5 in. deep.

The outside measurements of the upper tray is 39¼ in. long, 15 in. wide and 4½ in. deep, and the lower tray is 38 in. long, 17¾ in. wide and 6 in. deep. The levers *A* and *B* are each 9½ in. long, 1½ in. wide and ⅜ in. thick. The holes for screws are 8 in. apart from center to center. To prevent the cover from dropping too far back, bumpers *C* are provided at the ends. These pieces are each 6 in. long, 1½ in. wide and ⅜ in. thick. The lower tray rests on four knobs *H*, each 1 in. in diameter and ¾ in. long placed in the corners of the box at the right level.

The lever *A* is attached to the front corner of the tray ⅝ in. from the bottom and 1⅛ in. from the front. The arm *B* is attached to the end of the cover 1⅛ in. from the front and 3 in. from the bottom edge, and the opposite end is attached to the upper tray 1⅞ in. from the bottom and 8¾ in. from the front corner.

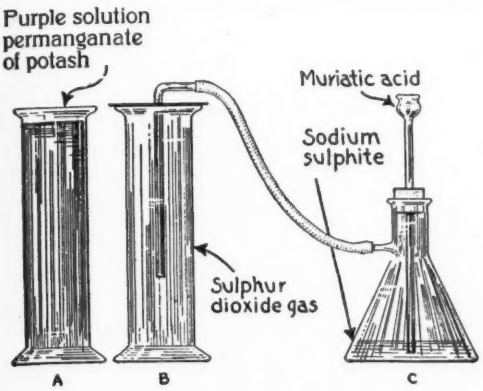
The piece *C* is attached to the box end on the inside so that its square end comes against the piece *A* when the cover is raised to the proper height required for its use.—GEORGE F. PETERS.

Chemical Action That Apparently Changes Wine Into Water

MAKE a deep purple solution of permanganate of potash in cylinder *A* by placing in the bottom one or two small crystals of the substance and filling with water. Fill cylinder *B* with colorless sulphur dioxide gas from generator *C*. Pass the gas through a perforated cardboard at the top of the cylinder and being heavy it will settle and displace the air. When the cylinder is full remove the cardboard and delivery tube and cover with a glass plate. The sulphur dioxide is generated, as shown in the diagram, by pouring diluted muriatic acid onto sodium sulphite powder.

Having prepared the two cylinders in advance of the demonstration remove the generator from sight and at the psychological moment pour the purple permanganate solution into the apparently empty cylinder of sulphur dioxide. As the purple liquid enters the cylinder it is immediately decolorized and seems to change to "water." The sulphur dioxide removes oxygen from the permanganate and changes it to a colorless compound.

The sulphur dioxide gas may also be generated simply by burning a small piece of sulphur in the cylinder. In either case



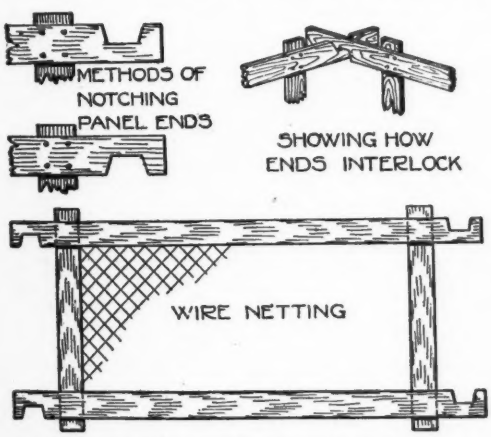
An apparent change of wine into water with the use of sulphur dioxide and permanganate

the cylinder should be covered with a glass plate until ready for use so as to prevent the escape of the gas.

A Handy Portable Fence Built in Sections

MANY styles of portable fences have been devised, but the one illustrated is of such a pattern that the panels may be used for a great variety of purposes.

The panels are 8 ft. long by 3 ft. high



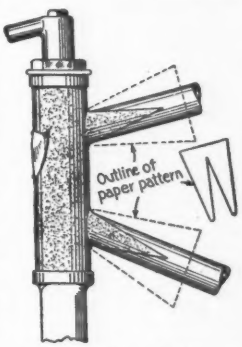
Frames made up of four boards and paneled with wire to make a portable fence

for general purposes; but, of course, the measurements can be changed to suit the conditions under which they are to be used.

By fitting several panels together in their various combinations many purposes can be served, as, for example, a four-sided or three-sided yard for poultry; fencing around a flower-bed, dog-yard or baby-yard, a continuous fence, trellis for flowers and many other things may be made. These panels are easily built of 3-in. "furring" and the required kind of wire. —L. B. ROBBINS.

Paper Stencil for Painting a Bicycle Head

WHEN the bicycle is to be repainted and it is desired to have the head a different color the V-shaped painting on the frame tubes presents considerable difficulty to the amateur painter. The illustration shows how this may be done by using a piece of paper with pointed notches to fit around the frame tubes. When this is put in place it makes a stencil, covering the parts not to be painted. The paper may be held in place with a cord tied around the end over the paper tube of the frame. —WM. THOMLE.



Painting the V-shape on a bicycle head

Polarity Determination for Plating Batteries

STUDENTS of electricity, when first they become acquainted with the subject, often find difficulty in remembering the polarity of the two poles of a battery or electrodes of an electroplating bath.

First, consider the battery. Instead of trying to remember the polarity of both zinc and copper, concentrate the attention on one only. If you can remember that *copper* is *positive*, you will know that the other element, zinc, must necessarily be negative. Bear in mind that carbon and copper, both beginning with C, have the same polarity. Copper is positive and so is platinum.

If the zinc and copper cylinders of a Daniell cell are connected by means of conducting wires to two plates of platinum,

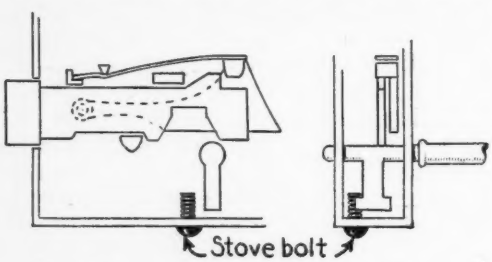
or the ends of the wires are connected together, and these are immersed in a chemical solution made by dissolving a metallic salt in water, they form what are termed *electrodes*. The positive electrode is connected with the copper or positive pole of the battery and, of course, the negative electrode to the negative pole. The effect of passing a current is to split up the salt into its metallic and acid constituents, and these make their appearance at opposite electrodes. The positive electrode is called the *anode* and it is here that acids appear. Oxygen, chlorine, and other non-metallic bodies, which play the part of acids, will be found at the anode. Having fixed this point, it is not difficult to remember that the metal constituent appears at the negative electrode, which is termed the *cathode*.

To further connect the words *negative* and *cathode* in the memory, remember this: Using a solution of copper sulphate and passing a current of electricity through the electroplating vat, the copper is deposited on the cathode; the acid forms around the anode.

Finally, bear in mind that all electro-positive elements appear at the negative electrode; while electro-negative elements go to the positive electrode. —PETER J. M. CLUTE.

Blocking the Skeleton Key in an Ordinary Lock

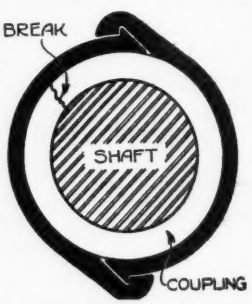
THE common skeleton key will open almost any of the ordinary door locks on the market. The writer had occasion to look into this after a friend's room had been entered and robbed of some fairly valuable tools. Removing and dismantling the lock, a small screw was inserted and tightened as shown by the illustration. The regular key was filed off to allow it to pass over this obstruction, but the lug on a skeleton key would not pass it to throw the bolt back. As the bar bolt and lever lay close to the inside plate of the box a considerable part of the regular key can be filed off and the key will still throw the levers perfectly. This allows the insertion of a fair-sized stove bolt in the bottom of the box to block the skeleton key. Of course, if entrance is desired by a graduate of the lock-breaking art, the finest piece of locksmith's skill and ingenuity amounts to nothing. But the petty lodging-house pilferer can be baffled for a brief time by this clever trick.—F. W. BENTLEY.



Placing a screw into an ordinary lock frame to stop the skeleton key from turning

Temporary Repair on a Boat Engine Shaft

WHILE on a cruise, the coupling on the main shaft of the boat broke and we had to be towed into port. To make a permanent repair would have cost considerably in money and time, to dismantle the plant and move the shaft, so we simply joined the coupling as shown. The break was closed by the well-known shrinkage process.



Two-part ring to shrink on a shaft

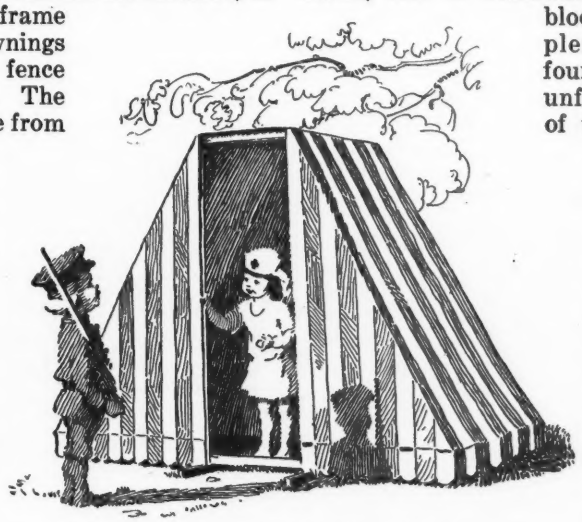
As we could not slip a ring over the shaft, it was made in two halves, each having a hook at one end and a notch or socket at the other. These were forged out so that their inside circumference would be a trifle smaller than the outside of the coupling. When heated they were easily slipped in place over the coupling, and in cooling they closed in on the parts, pulling them together.—JACOB HARSEN.

Treating a Clothes-Line to Prevent Its Stretching

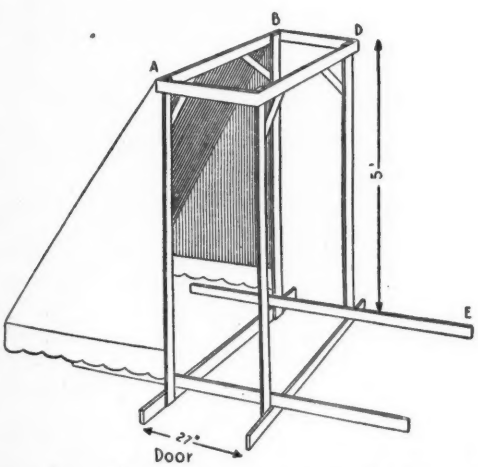
THIS can be accomplished by boiling an ordinary rope clothes-line in water. A new line thus treated will not stretch but will retain its firmness.

A Child's Play Tent Made Out of Awning Covers

HAVING some old awnings stored, which were too old to put on the windows, a householder made use of them to construct a play tent for his children, as illustrated. The frame for holding the awnings was made from fence pickets 5 ft. high. The width of the frame from *A* to *B* depends on the width of the awnings. At the place marked *C*, about 10 in. from the bottom, the cloth was fastened with screws, using a metal bottle cover for a washer over the cloth. Two awnings were used complete, one on each side, and the third awning was cut apart and used for a cover and a back, allowing the front to remain open for entrance.



Window awnings joined together with an extra piece at the top to make a door in the side



A frame made of fence pickets for holding the window awnings for making a tent

If the two pieces used beneath the frame are made curved at the ends like a sled runner the whole structure can be moved about as desired.—F. P. TONSOR.

An Efficient Substitute for an Automobile Jack

IN case a tire goes flat on the road and, when about to repair it, the jack is missing—having been left in the garage at home, lost or otherwise—and no poles, blocks or other implements may be found to raise the unfortunate corner of the car, proceed as follows:

Scrape up enough rocks, pieces of wood, etc., to build a foundation from the ground up to the lowest substantial point of the said corner, and with a screw-driver, tire tool, axe, hatchet, hand shovel or other appropriate tool, begin to excavate the material from under the tire. As the excavating proceeds the car will settle a little and soon the tire may be removed, repaired and replaced. The hole is then filled as nearly to the original level as possible, the foundation knocked out, and the car proceeds on its way, or, if it happen to be a front wheel which gives the trouble, the engine is started and the car driven off the foundation.

Extinguishing Materials for Fires Caused by Electricity

THE time element is a very important consideration in the extinguishing of electric fires, and there is a good opportunity for the display of good judgment and prompt action.

First, if possible and if conditions warrant it, the current should be cut off from the affected part before the fire is attacked.

Although their use is limited, sand and powdered soda bicarbonate are found to be good extinguishers in certain kinds of electric fires. The sand provided for such usage should have been carefully sifted

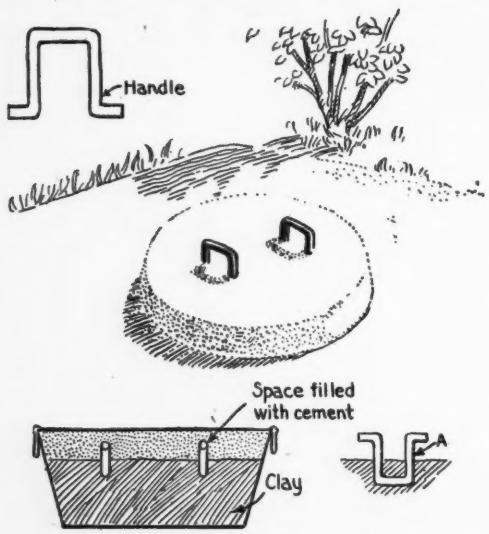
through a fine-mesh sieve to remove the larger particles and foreign matter, and should be stored in a bin in a dry condition. In extinguishing a fire in a machine where the sand might get into the bearings of movable parts, sand should not be used.

For oil fires, wet sawdust saturated with sal ammoniac has been found quite meritorious.

Carbon tetrachloride has stood severe tests as an extinguishing fluid, and has the added advantage of being a non-conductor.—PETER J. M. CLUTE.

Making a Round Cement Cover for a Cistern

THE boy of the house can make a substantial cistern cover by making a study of the illustration. The form for shaping the cover is the top portion of a



An ordinary metal wash tub used as a form for making a round cement cistern cover

wash tub. Fill the tub with gravel or clay, leaving 4 in. of the top unoccupied, smooth and pack the surface of the filling. The heavy rod handles are sunk half way into the clay, as shown at *A*. The concrete is poured around the open ends which stick up into space. The top of the clay should be neatly covered with paper before the mixture is poured. Iron rods may be used for reinforcing, but they are put in after the pouring. Make a mixture of 1 part cement and 4 parts sand and when dry-mixed well, add water and keep turning over until it is like butter. Fill the space in the upper portion of the tub and in 15 minutes strike off the top with a straightedge. After a while smooth it with a wood trowel or float and finish with a steel trowel. Do not touch it for two weeks and then you may turn the tub upside-down and a neat and lasting cover will drop out.—H. ALDEN.

The Economical Use of Gasoline in Automobiles

DURING the past few years gas and gasoline engines have taken the place of steam engines in many power plants and, together with the enormous expansion of the automobile industry, have greatly increased the demand for gasoline. Before the time of automobiles gasoline was considered a by-product in the oil industry and many means were devised to make use of it. Owing to the increased demands for this volatile liquid the refiners have been forced to bring into gasoline heavier elements with a loss of volatility.

With this increase of a heavier oil it has become necessary to provide carburetors that will handle the present-day gasoline in an economical and efficient way. Gasoline cannot be used as a fuel in internal-combustion engines while in a liquid state, and owing to the increased amount of heavier elements it is necessary to have a higher temperature for vaporization. This trouble is experienced more during winter, and it makes economical consumption difficult.

On the older types of automobiles there was no control on the steering post or dash for supplying a change in mixture for starting and operating a cold engine, nor was there any hot-air equipment to facilitate the evaporation of the fuel.

The carburetor should never be adjusted before the engine has been allowed to warm up and the cooling water should reach a temperature of 160 deg. It is impossible to vaporize all of the gasoline at a less temperature, and a rich setting will be the result if the carburetor is set before this temperature is attained. A dash control will enable the driver to reduce the amount of air and increase the amount of gasoline while driving the

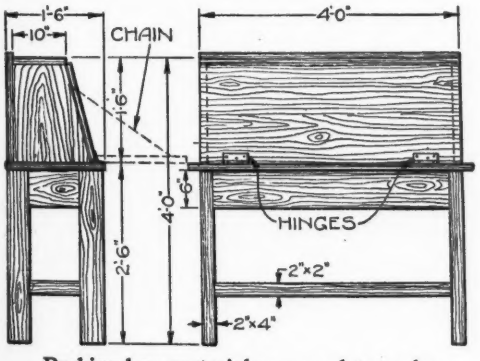
engine cold. While this will limit the flexibility for a time it will prevent the waste of gasoline after the engine has reached the proper operating temperature.

The best method of heating up, as well as of running is to equip the engine with a hot-air stove. This should have sufficient capacity to heat the air entering the carburetor to temperature of not less than 160 deg. The tubing conveying the air from the stove to the carburetor should be of ample size and as short as possible to prevent restriction of the air flow, which would reduce the power. It is desirable to have an adjustable opening in this pipe so that cool air may be admitted on hot days.

The correct ratio of gasoline and air for a perfect mixture is .08 lb. of gasoline to 1 lb. of dry air when the engine is running with cooling water at 160 deg. An increased amount of gasoline will decrease the power. This fact is in a large way responsible for the unnecessary fuel consumption experienced by many motorists, and when adjusting the carburetor it is recommended that the gasoline adjustment be reduced to a point where the engine commences to lose power and then gradually opened until the normal power is attained.

An Inexpensive Field Desk for the Army Camp

THE accompanying illustration shows the simple construction of a field desk. This desk was designed so that it



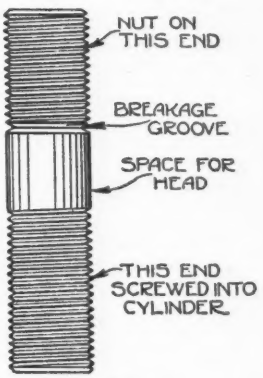
Packing box material was used to make this handy field desk for an army officer

can be made from old lumber or packing cases. The parts are cut from 2 by 4-in. material 2½ ft. long and braced with a 2-in. rail about 8 in. from the lower ends. The upper ends are joined with a 6-in. rail on which the top board is fastened. The top is 1½ ft. wide and 4 ft. long.

The desk part is built up 1½ ft. high with a sloping cover. All the things necessary outside of the lumber are two hinges and some nails. A lock may be attached to the desk for additional security. — GEORGE M. PETERSEN.

Breakage Groove in Cylinder Head Studs

IT sometimes happens that when cylinder heads are blown off a part of the cylinder is broken out, due to the studs being stronger than the metal in the cylinder. This causes a delay in either replacing the cylinder or welding the piece in place. By using a cylinder head stud with a breakage groove in it, as shown in the illustration, the liability of breaking the cylinder is reduced, as the stud will give way under excessive pressure before the head. The size and depth of the groove is governed by the size of the stud and the pressure in the cylinder. By locating the groove as shown the stud can be easily backed out in case of breakage. —J. R. MINTER.



A breakage groove at the thread end

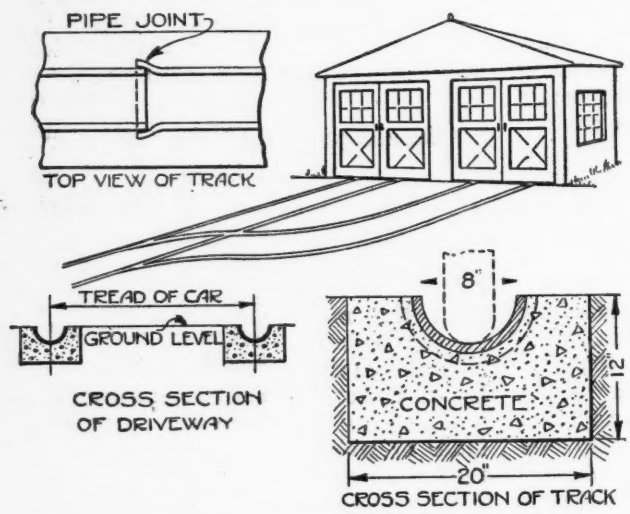
Clamping Pieces for Gluing on a Bench Top

WHEN fastening two or more pieces of wood together, it is usually difficult to hold the pieces tightly together, especially if the work is very wide and no clamps are available.

This difficulty can easily be overcome by placing the work between pieces of wood fastened securely to the back of the bench and a bench-stop in the vise. The vise can be tightened until the pieces are in position and then fastened.

Runway Guide Tracks to Facilitate the Entering of a Garage

PRIVATE garages are commonly placed on a back corner of a lot. It is usually a difficult place to enter with an automobile, and a more difficult one out of which to back a car. For this reason, I made guide tracks, as shown in the illustration. Trenches about 2 ft. wide were dug in the ground at the proper width to accommodate the wheels of the automobile and into these cuts concrete was poured. Halves of earthen soil pipes were then set in their upper surfaces. A cross-section view of the trench and pipe is shown in the illustration.



Guide tracks made of split tile set into a concrete base and their use with a switch for a double garage

Where there are double entrances to a garage, a switch can easily be made by cutting the pipes on an angle. Ordinary 8-in. soil pipe is used and each joint is cut in half, making two pieces. The concrete is laid in wood forms, which are removed after the concrete has set. The soil is filled in close to the concrete, then the surface is covered with sod so that a level surface is produced with the exception of the hollow made by the tile. The hollow of the tile guides the front wheels easily so that in entering the garage a driver need not fear the striking of the door. Such guide tracks may have grass growing close to the surface of the concrete base.—P. P. AVERY.

Secret Door Lock for the Executive's Private Office

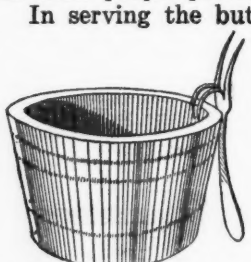
EXECUTIVES often desire privacy, but find it difficult to keep visitors and employes from entering their offices. Of course a clerk stationed at the entrance can somewhat relieve the situation. It would not be feasible to have the door locked at all times, as it would give the impression that the executive's door was not open for visitors, and it would make it rather embarrassing to all concerned should some one, who has authority to enter unannounced, try to get in during the assistant's absence.

A simple electric arrangement, which can be installed by any electrician at a comparatively small cost, connects a bolt in the door with a push button under the desk, so that the officer simply has to push the button to lock the door, without any noise, conveying to the caller the information that the executive does not wish to be disturbed. Another button unbolts the door.—KARL M. WEHINGER.

A Butter-Chip Fork for Use in Restaurants

IN every restaurant where the practice of serving meals in a hurry is the main feature it is necessary to have everything needed for the usual table requirements in their proper place.

In serving the butter chips, or rather in putting them on their respective small dishes from the butter tubs, requires the use of a fork for handling the pieces.



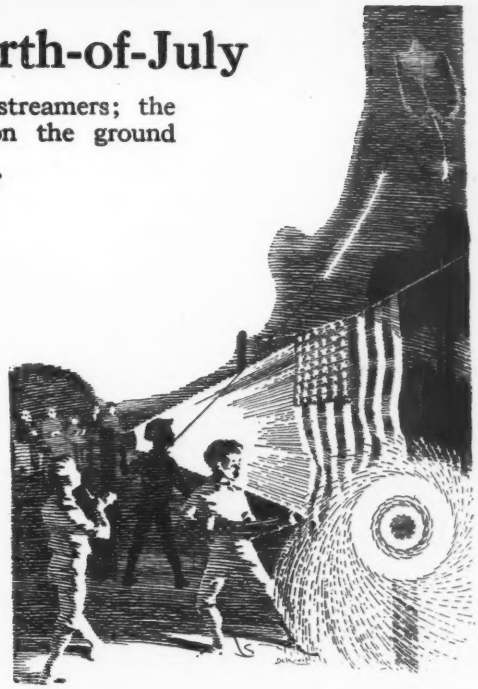
Bent center prongs make holding hook

An inventive waiter devised the use of a butter-chip fork made by bending an ordinary fork in the form of a hook to hang over the edge of the butter-chip tub.—R. O. HELWIG.

Helps for a Sane Fourth-of-July

Novelties in the way of kites with streamers; the use of sparklers in the air and on the ground

By C. M. Miller



PATRIOTIC exhibitions are very popular these days and especially so as we near our great National holiday. How shall we celebrate this year? In the daytime we may well turn our attention to kites and kindred air devices, the national colors being exclusively in vogue. There are many-shaped star kites that are beautiful in form and which may be further embellished by the addition of fringes, streamers, etc. The star-and-crescent is not so popular now, as it is found on a flag that belongs to an enemy, but shield shapes and eagle kites with suspended star-spangled banners thrill us at any time. Hot-air balloons may also be made up of the National colors in tissue paper, and gas balloons may be sent up in groups, too. Large parachutes can be released from the kite lines high in the air, or a score or more of small ones may be released at the same time to come floating down "somewhere in America," not very far away from the starting place.

One kite may be made red, another white, a third blue, and this may be repeated, all being attached to one line;

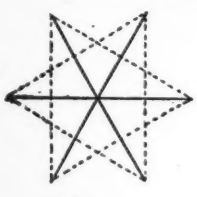


Fig. 1

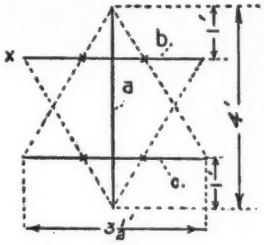


Fig. 2

A six-pointed star kite made with three sticks with cross bar or a spine

if they fly well, the number can be increased to fifty or more. It is well to so adjust the bridles that one will stand out on the right, another to the left, and so on, the effect being more beautiful.

Sometimes a kite line is decorated with pennants for a long distance and these may vary in lengths, some being 3 ft., some 10 ft., and so on. If these are turned on the edge a little, like a small hem, they will wear better. They should be placed quite a little distance, perhaps 20 ft. or more, apart.

A beautiful exhibition is the unfolding of a good-sized flag far up in the air. It may be rolled up and at the right time released by an extra string to the ground.

Airplane kites will be attractive and popular. They may be decorated with identification marks as is used by our aviation designs. These kites will require careful making and should be started sometime before they are to be exhibited. They are of the box-kite order and need more tryouts to get good balance, etc., before they can be relied upon.

The six-pointed star kites are the most familiar perhaps as regards the making. They may be made with three sticks crossing each other, as in Fig. 1, or they may be made with a spine, *A*, Fig. 2, and two bow sticks *B* and *C*. In either case the string is stretched from one point to a second point beyond in series around the kite. Supposing one end of *B* was a beginning, the string would pass to the bottom of *A* and then up to the other end of *B*, called for convenience *X*. Next a string would pass from the end of *C* to the top end of *A* and down to the

other end of *C*. These lengths of string should be all the same. If we should make a 4-ft. kite, the upper cross piece *B* of Fig. 2 would be down 1 ft. from the top end and the cross piece would be 3½ ft., *A* being 4 ft. If the spine *A* was

Fringes attached to festooned strings or tails may form a very attractive decoration

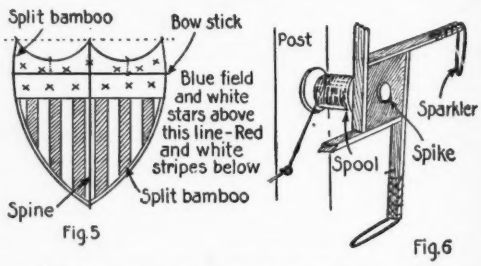
3 ft. the cross pieces would be about 6 in. from each end of *A*, and these pieces would be about 2½ ft. long. A string all the way around the outside ends helps to strengthen and gives opportunity for attaching fringe. The fringe is not necessarily limited to the short lengths of paper, but ribbons of paper 2 ft. long would be very pleasing. Fringes may be attached to festooned strings from the ends of *B* to the bottom of *A*, as in Fig. 3. The tails may be a very attractive part of the kite, as in Fig. 4. The trailing lines are very artistic but they should not be the same length.

The tailless kite may be easily shaped into shields, etc. In Fig. 5, the spine is 4 ft. and also the cross stick, their union being 10 in. down from the top of the spine and placed in front where they are lashed together. The curved outline will require some split bamboo which is lashed to the bottom and top of the spine and at both ends of the bow stick. The depressed bows at the top will need to be tied down to the spine as shown.

In covering, the blue field should extend about 6 in. below the bow stick, otherwise the upper portion will look small in comparison. In putting on stripes, cover with red or white and then paste strips of the other color over the first ones.

At night colored lanterns can be carried up by kites so that they will hang in the sky, but the more interesting are the safe light exhibitions by means of sparklers, red light and similar mediums. An attractive device is the whirligig which may be arranged with different lengths of arms from the center block so as to produce a spiral effect. A square block of wood, 1 in. thick and 3 by 3 in. is nailed to a large-sized spool and a hole is put through the block so that a large-sized nail can be put through both to fasten the device to a post of some kind, as shown in Fig. 6. The nail must not be driven in too tight as the spool must turn freely. A screweye placed a little way from the spool will prevent the entanglement of the string with the arms carrying the sparklers. The string is wound on the spool and, when pulled, unwinds and causes the device to turn. The arms may be ¼ by ½ by 8, 12, 16 and 20 in. respectively. The sparklers can be wired to the arms with small wire and should be turned back in the direction opposite to that in which they are to move. Use about 50 ft. of strong cord, not too large.

A pleasing exhibition is the illumination of a flag. A new can or bucket may be used as a reflector and the box of fire powder (red perhaps) may be set inside.

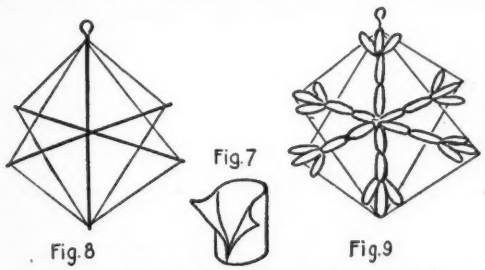


A tailless kite is easily shaped into shields with split bamboo lashed to the parts

The flag may be suspended all the time or may be rolled up and released at the right time; the latter is more effective. The light must be so confined as to shine just about the flag. The side of the can may be cut so as to force the tin back, opening up sufficient to let the light out

on the side of a flag as in Fig. 7. It is not necessary to have a top in the can. Any tinner can cut the side for you if you do not possess a pair of tinner's snips, or a can opener will do the work.

An easy stunt is to bend the ends of the wire of six or eight sparklers so as to form a loop on each and with a string, perhaps 15 ft. long, tie these sparklers at



A light reflector for a flag and a frame to fasten on sparklers for an attractive design

regular intervals. After the sparklers have been lighted two persons turn the string like a skipping rope. This can be further extended by adding three or four groups of skipping ropes of light. To light these sparklers, collect all of a string without entanglements so that the ends may be brought together in a bunch with the lighted sparklers; the heat being intense, the lighting must be done quickly.

One might insert a wire in a kite line and with a suspended wire from this section attach sparklers so that they would touch each other and as one burned to the end it would light the next. To get the lighted sparklers in the air, the device should be worked up well into the air before lighting, then someone should follow along the line and draw the line down gradually, leaving another person holding the string at the starting point. When the device is reached the lowest sparkler would be lighted and the string released at this point; then the pull would come back to the starting point and thus raise the device up in the air again. By a little manipulation the device could be made to whirl around the kite line.

An illuminated spray from a garden hose may be planned as follows: Take a tin can about 6 in. in diameter and high enough to hide the direct light of the fire. Make a hole about 1 in. from the bottom large enough to receive the garden hose. Screw on the sprinkler after the end of the hose is inside. Place a block of wood in the bottom as a rest for the sprinkler and set a red or green fire-powder box in the bottom of the can. Light the powder and turn on the water. The fire should not be placed under the hose, but to one side.

If there is plenty of room, blunt-pointed darts may be used to propel lighted sparklers through the air like falling stars. The dart is thrown with a springy stick and string, and will take the lighted sparkler high in the air. Care must be taken that these do not alight on inflammable material before they are burned out. Very pretty effects are obtained by a group flinging the lighted sparklers by hand, one group throwing to the other. Good sparklers may be thrown two or three times each.

Set pieces of beautiful designs may be easily worked out and all of this will be much enhanced if the windows of the homes are illuminated with the National colors, and lanterns are hung in the porches and from the trees of the yard; these, too, of the red, white and blue.

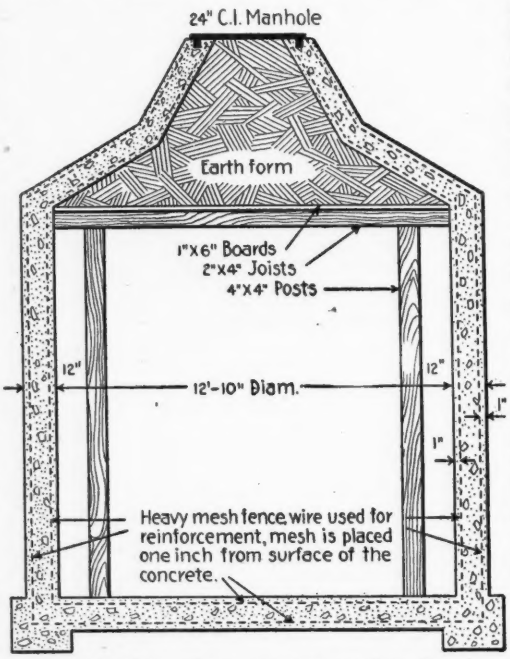
A frame for a very interesting piece can be made of wire, as shown in Fig. 8. The three heavy lines are for the framework, and the light lines are light stay wires. The sparklers are wired to the frame, as shown in Fig. 9. The sparklers must overlap each other sufficiently to light the succeeding ones. The light is applied to the center and in a short time six sparklers are burning; as the outside arms are reached, eighteen are burning at one time. The design can be modified in many ways so as to make a more extended illumination. Thirty sparklers are necessary for the design in Fig. 9.

An illumination of the flag that is not original, is to carry an electric cord to the top of the flag pole and with a bulb housed in a reflector, so that it will not be in view from below, throw the light on the flag. It would be very fitting if all of our homes might have this last exhibition on July 4, 1918.

Kites of the designs shown and the whirling devices are not expensive to make and the kinds of illumination not costly, which should be in the minds of every patriotic citizen during our struggle with war conditions and to celebrate the day in which our independence was declared.

Concrete Cistern Used for Water Pressure Supply

THE cistern illustrated is located above ground or at some convenient place or high spot on the farm so that it will be possible to have water under pressure in all the departments of the farm. The water is pumped into the cistern by the farm windmill or gas engine. If a hill or high place is near, the cistern may be placed beneath the ground, which is much better than above the surface, and for the beginner is a much better form to construct. Details will be for the underground cistern. The cistern is round, 12 ft. in diameter, and, for the average farm, about 14 ft. deep. Dig the pit about 2 ft. larger on each side so that there will be room enough for a person to climb down beside the forms to fasten them securely. It is very essential in this work to have everything true and plumb and have the forms solid and secure to prevent any bulging. Build the floor first, which should be at least 10 in. thick and reinforced with heavy wire mesh fencing such as is used in the walls. Let the reinforcing steel project up at least 2 ft. all around the floor so that when the walls are built it will make the bond complete and a very solid joint. Let the floor harden for a day or two before the forms are set for the walls.



Construction of a concrete casing for a cistern or water tank set on a high place for supplying farms or country houses with water

The wall forms are not difficult to build. They consist of battens, 3 in. wide and 3/8 in. thick, which can be purchased from a local lumber yard. These strips are easily bent to a 12-ft. diameter; then nailed to uprights of 2 by 4-in. material. Build the forms on the outside of the pit, then set them in place. The outside form will have a diameter of 14 ft. When the two forms have been set, wire them together and to each upright, to prevent any possible bulging when the heavy concrete is poured into them. When the forms are removed, clip the wires off even with the concrete. Build the cover over a clay form as shown. Moist clay is packed in the proper shape on a false floor made of 6-in. boards supported on posts. A cast iron ring should be set into the concrete while it is soft.

The best concrete mixture for this purpose is 1 part cement, 2 parts sand and 4 parts clean, well graded gravel. Mix the concrete to a "quaky" consistency and use care in setting the forms and the reinforcement, so that the whole cistern will be a permanent structure. In making two forms with a space between for the thickness of the wall they can be used in a pit or outside as desired. If the cistern is placed in a pit the earth is filled in after the concrete has set.—W. E. FRUDDEN.

Solution to Make Drill Point Bite Into Tempered Steel

THE worker in steel often finds it desirable to bore holes in parts of machines that have been tempered. By using the following solution on the drill point, a hole can easily be bored through a tempered steel spring or other machine part. Make up a strong solution of camphor in turpentine, shaking the bottle until the camphor is dissolved. Put the drill on as slow a speed as possible and keep the cutting edge continually wet with the camphor solution.

The camphor may be readily dissolved in a small quantity of alcohol and then added to the turpentine.

Electrical Devices and How They Work

VII.—Electrochemical Decomposition

By Peter J. M. Clute, B. E.

WHEN a quantity of electricity is passed through a dilute sulfuric-acid solution, using platinum electrodes immersed in the acid, gas is evolved at each electrode. These gases may be separately collected in tubes filled with the solution and inverted over the electrodes, as shown in Fig. 1. The gas liberated at the positive electrode is found to be oxygen, while that at the negative is hydrogen; and the volume of hydrogen is just twice the volume of the oxygen. These volumes are exactly in the ratio in which the gases combine to form water, (H_2O), and on this account it was first supposed that the current directly decomposes water.

Current passing through a conducting liquid of a compound nature, called an electrolyte, decomposes the liquid. The electrolyte is always decomposed during the passage of the electric current, and the process of decomposition is called electrolysis. In Fig. 2, the plates suspended in the solution are called the electrodes, the positive plate, by which the current enters the solution, being the anode, and the negative, by which it leaves, the cathode. The passage of the current is attended by the movement of dissolved particles through the solvent toward the two electrodes, and it is by means of these particles that the current is carried. The moving particles are termed ions (from the Greek, meaning "to go"), those moving toward the anode being called anions, and those toward the cathode, cations.

During electrolysis, decomposition products of the electrolyte are deposited on the electrodes or concentrate about them. Thus, when copper chloride undergoes electrolysis, the copper is deposited on the cathode, while the chlorine gas is set free at the anode, the products of decomposition thus appearing at places which are a distance apart.

The most common electrolytes are solutions of compounds in water, but most compounds that conduct electricity may be considered electrolytes, or conductors of the second class, as they are frequently called, to distinguish them from elementary conducting substances, which, of course, cannot be decomposed and are classed as conductors of the first class. Conductors of the first class have an increased electrical resistance with increase in temperature and are not decomposed by an electric current; those of the second class have a decreased resistance with increase in temperature and can be decomposed by a current of

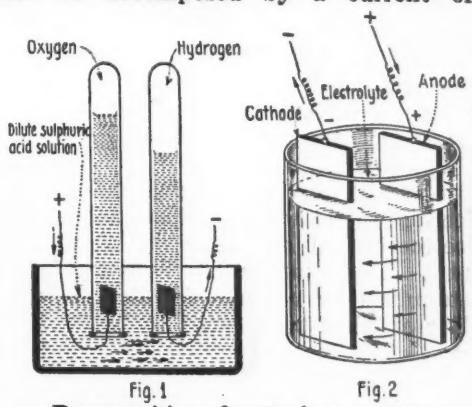


Fig. 1 Fig. 2

Decomposition of water by a current of electricity and an electrolytic cell

electricity. These are the distinguishing characteristics of the two classes of electrical conductors.

The earlier conceptions of electrolysis supposed the decomposition of the electrolyte to be effected by the electric current, but it is now believed that a large percentage of the electrolyte is ionized, or broken into positively and negatively charged ions, as a result of going into solution, and that the electric force in the electrolyte is simply directive, causing the positively charged ions to move with the current and the negatively charged ions to move in the opposite direction through the solution until they reach the electrodes where their charges are released and the molecules are set free in the neutral state. (See Fig. 3.) The current is supposed to be made up of the charges which are thus carried convectively by the moving ions.

All the molecules of a compound are not dissociated into ions except in very dilute solutions in which the solvent has a strong ionizing power; that is, a power of resolving molecules into ions. Also, liquids vary as to ionizing power, water being one of the strongest. Many organic liquids do not ionize molecules at all; and some compounds are not ionized in any solution. All conducting solutions contain ions; non-conducting solutions do not.

When an electrolyte is decomposed, the amounts of the various substances liberated are proportional to the quantity of electricity passing through the solution. The amount by weight of any element that will be liberated by a given quantity of electricity is proportional to the chemical equivalent of that element. Thus, for instance, a quantity of electricity that will liberate 1.008 grams of hydrogen will also liberate 8.0 grams of oxygen, or 63.57 grams of copper, or 107.88 grams of silver, etc.

The amount, in grams, of any element that will be liberated by one coulomb of electricity (one ampere per second) is the electrochemical equivalent of that element. This quantity has been carefully determined by research for the element silver and has been found to be .001118 gram. The method employed is as follows: Referring to Fig. 2, an electrolytic decomposition cell similar to that shown is used. Anode and cathode are of silver, dipping in an electrolyte, which is a solution of a salt of silver, generally silver nitrate ($Ag\ NO_3$). The cathode is carefully cleaned and weighed before being placed in the electrolyte, and after passing a known current for a definite time through the solution, the cathode is removed, carefully dried, and again weighed. The increase in weight, in grams, divided by the total quantity of electricity passed through the cell, gives the weight in grams deposited by one coulomb, which is the electrochemical equivalent of silver. The electrochemical equivalent being known, it is apparent that such an arrangement can be employed in the measurement of electric current, and the apparatus used for this purpose is termed a voltameter.

The following table gives the electrochemical equivalents of some well-known substances. It will be noticed that they are proportional to the combining equivalents:

In the process of electroplating, advantage is taken of the fact that when an electric current is passed through a solution containing the salt of a metal, the metal will form a deposit on the negative electrode.

Referring to Fig. 4, consider the process of copper-plating. The iron rod to be plated is placed in a copper-sulfate solution ($Cu\ SO_4$), together with a strip of copper, as shown. When current passes through the cell, it decomposes the copper-sulfate solution into a copper part, Cu, and an acid radical, SO_4. The copper, being positively charged, goes with the

ELECTROCHEMICAL EQUIVALENTS

Element	Symbol	Atomic Weight	Valence	Chemical Equivalent	Electro-chemical Equiv.
CATIONS:					
Copper	Cu	63.57	I	63.57	.00065883
Gold	Au	197.2	III	65.75	.00068090
Hydrogen	H	1.008	I	1.008	.00001044
Nickel	Ni	58.68	II	29.34	.00030404
Potassium	K	39.1	I	39.1	.00040555
Silver	Ag	107.88	I	107.88	.00111800
Tin	Sn	119.0	II	59.5	.00061636
ANIONS:					
Chlorine	Cl	35.46	I	35.46	.00036710
Oxygen	O	16.00	II	8.0	.00008283

By means of the table given above, the amount of any metal necessary to produce a given current for a certain length of time, can be easily determined

current in the solution to the negative electrode, the iron rod, and forms a deposit on it, thus giving it a coating of copper. The acid radical, SO_4, having a negative charge, goes against the current to the positive plate, and combines chemically with it, forming more copper sulfate.

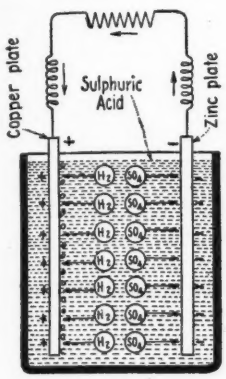


Fig. 3

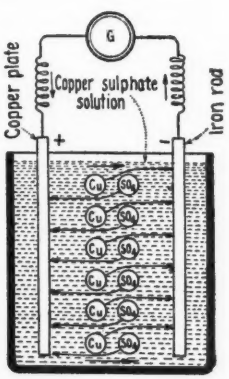


Fig. 4

Electrolytic action within a simple cell and a chemical action in a plating bath

Thus, the copper strip is gradually consumed and deposited on the iron.

When it is desired to nickel plate, a piece of nickel is used for the anode, instead of copper, and nickel ammonium sulfate for the electrolyte, in place of copper sulfate.

Since one ampere-hour of current flowing through an electroplating bath will deposit a definite amount of pure metal on the negative plate, unknown

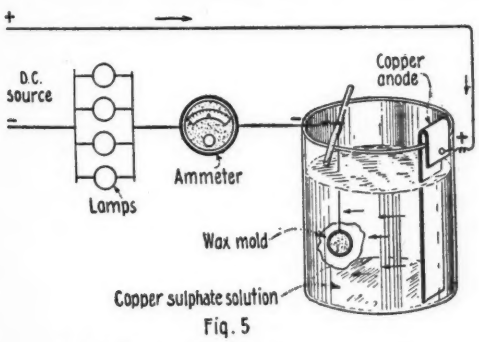


Fig. 5

An electrotyping solution in jar with proper connections to a direct current

currents can be very accurately determined by finding the increase in weight of the plate after a definite period of time. It is from a similar consideration that the following definition for the unit of current, the ampere, has been established:

An ampere is the rate of flow of a steady current which deposits 4.075 grams of silver per hour from a solution of silver nitrate diluted to a standard density with pure distilled water.

One of the methods wherein electroplating is of commercial use and importance is in electrotyping. The object of this process is to reproduce for press-work printers' set-up type, engraving, etc. First, a wax impression is made of the set-up type; since wax is a non-conductor of electricity a thin coating of powdered graphite is next given the mold. The wax mold with its graphite coating is then immersed in a copper sulfate solution together with a copper bar. An electric current being passed through the solution, copper is deposited in the graphite similarly to the method in which it was deposited in the electroplating vat. A plate of sufficient thickness for safe handling is obtained before the circuit is broken. The wax impression is then melted off in hot water and the remaining copper plate is an exact reproduction of the type. After being backed with type-metal, an alloy of lead, the electrotype is ready for use.

In the processes described, the metal deposited on the negative plate or electrode is remarkably pure, and methods similar to these are often employed to separate metals from impurities. The impure mass being connected as positive plate, upon the passage of current, the pure metal is gradually dissolved by the electrolytic solution and transferred to the negative plate. Practically all the impurities remain at the positive electrode, and thus the negative plate will be found to have obtained a thick coating of very pure metal.

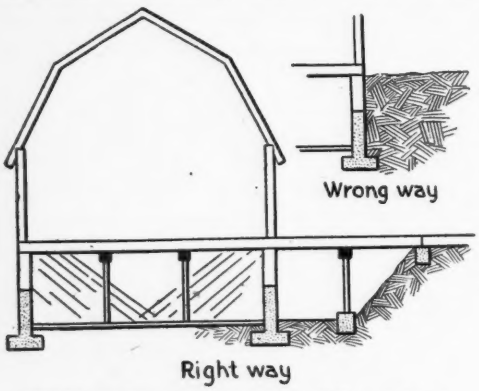
(*To be continued*)

Taller Towers at Nauen Station Increase Sending Range

IMPROVEMENTS made in the wireless station of the German government at Nauen enable it to transmit signals 6,200 miles. It now has several additional towers, ranging in height from 890 to 360 ft., which are employed in transmitting wireless messages.

The Construction of a Sanitary Bank Barn

THE old-fashioned stable under a bank barn is always warm in winter and cool in summer, but it is usually so



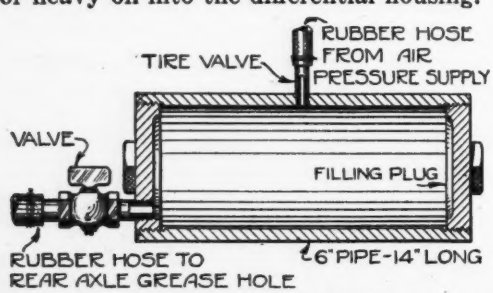
Right and wrong ways of building a barn near a bank to make conditions sanitary

damp that it is an unhealthy home for the stock housed within its walls.

The illustration shows the old style bank barn, and also a way to construct a sanitary barn that will be warm or cool in the proper seasons, yet light and well ventilated from all sides. The bank is kept far enough away from the wall to prevent dampness. The upper floor may be easily reached by means of a bridge. —W. E. FRUDDEN.

A Grease-Filling Pump for the Automobile Rear Axle

THE average car owner always dreads the operation of putting light grease or heavy oil into the differential housing.



An air-pressure grease-filling device for use on the rear axle of the automobile

It is always a slow process with a small hand grease gun to put 4 or 5 lbs. of grease through a 1½ or 2-in. hole. A pump can be easily made that will greatly aid in doing this work in a cleanly manner. Procure a piece of heavy iron pipe 14 in. long by 6 in. in diameter and fit it with a plug at each end. In one plug, near the lower edge, drill a ½-in. hole and turn in a nipple with a shut-off valve. To this valve clamp a piece of heavy ½-in. hose about 5 in. long. In the top of the large iron pipe drill a ¼-in. hole and fit in a regular tire valve. Connect the valve on the top with the regular air pressure, same as if for inflating a tire. Open the valve near the hose that leads to the hole on the differential housing and the grease is forced in quickly. This will be found to save considerable time and is efficient and cleanly.—P. P. AVERY.

Telephone Receiver Used to Detect Grounded Armature

A SIMPLE method for locating a grounded coil in an armature will appeal to all electricians having to care for motors or generators. The test described can be made without removing the armature.

Remove all the brushes from the commutator with the exception of the two

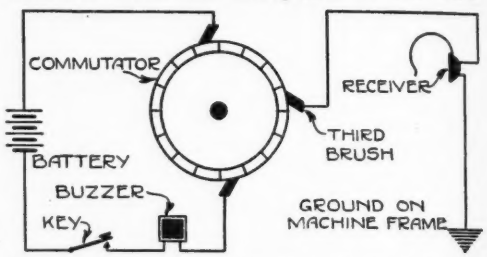


Diagram showing how to make test for a grounded coil without removing armature

located diametrically opposite. These brushes are connected to a few cells of dry batteries and a buzzer, as shown in the sketch.

A telephone receiver has one terminal connected to the frame of the machine, while the other terminal is connected to a third brush, which bears on the commutator midway between the other two.

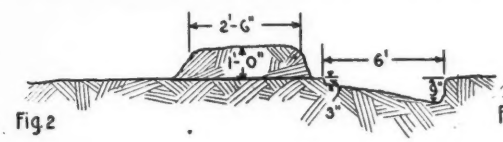
On starting the buzzer a sound will be heard in the telephone. The armature should be turned slowly, keeping the brushes in the same relation to each other, until no sound is heard in the telephone; this will indicate that the bar connected to the grounded coil is under the middle brush.

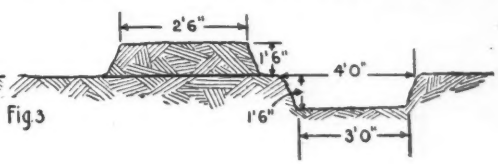
"Digging In" and Making Army Field Fortifications

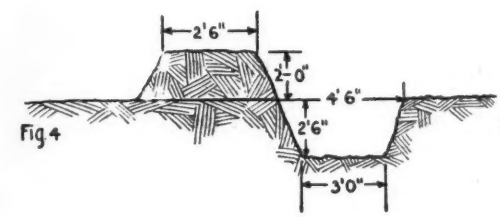
AS looked upon by the general public, intrenchments and field fortifications in general require considerable time to build and the remark is often heard, "I wonder how they could intrench at that point." Certain types of fortifications in the field do require considerable time, but the most commonly used trenches are built or can be built under fire. They are simply a case of evolution from one little hole in the ground to an elaborate intrenchment.

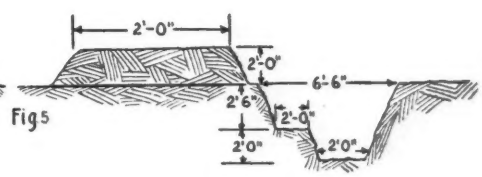
In Fig. 1 we see two soldiers, one of whom is firing at the enemy while the second one is excavating a small hole for himself. After the first soldier "digs himself in" he will take up the firing while his "bunkie" also digs a little hole. By connecting these "holes" together, as quickly as the enemies' fire will permit, they soon have the "lying trench" shown in Fig. 2, and from then on the work of completing the fire trenches is comparatively simple. The lying trenches are gradually deepened and enlarged until we have the "kneeling trench" shown in Fig. 3, and later the "standing trench" shown in Fig. 4 and 5, the latter being a complete standing trench. It is hard and dangerous

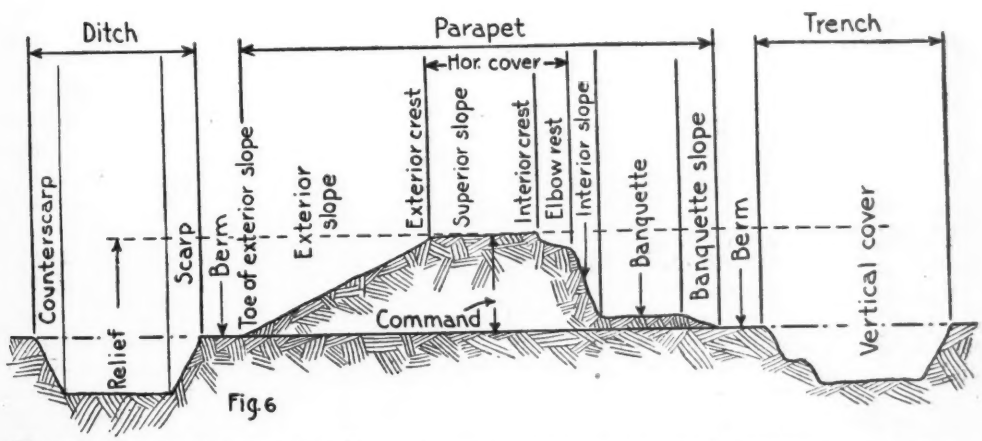
Fig. 1. One soldier firing at the enemy while the second is digging out a small burrow for himself











The earth is excavated from the lying trench until the different stages are reached; the kneeling and standing trenches are thus constructed. It is hard and dangerous work as it is done under fire

work, this digging in under fire, but in many cases it must be done in order to hold ground which has been won, often at fearful cost.

A completed trench, shown in Fig. 6, gives the names of the various parts. The "ditch" in front of the parapet and the ground in front of the ditch are filled with obstacles, barbed wire entanglements, trees, stakes, spiral wire and all sorts of obstructions which will cause confusion among the enemy when they attempt to storm the position. Of course the artillery usually blow the entanglements and obstacles to pieces before the infantry attempt to make an assault, but even then the shell craters make a quick rush out of the question.

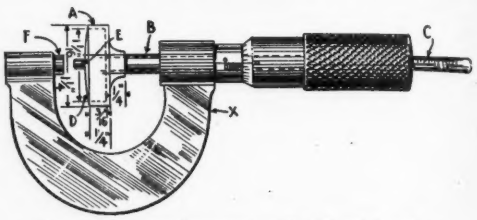
The trenches are generally attacked under cover of a barrage fire, a rain of artillery shells, under protection of which the infantry advance slowly toward the enemy. The barrage fire is lifted every few seconds so that the infantry may keep advancing slowly but surely and, at a set time, the artillery fire ceases and the infantry plunge forward rapidly to make the attack.—GEORGE M. PETERSEN.

How to Make an Efficient Hydrostatic Micrometer

IN the construction of this gage an ordinary micrometer must be used. A hollow chamber, *A*, with an attached hub is accurately turned from a piece of machine steel 1¼ in. in diameter, to the dimensions given in the illustration. A hole is drilled in the hub to fit over the hammer or spindle of the micrometer. This spindle, if the regular one is used with the micrometer, must be annealed and a ⅛-in. hole drilled centrally through it. This is for a small glass tube, *C*, (a clinical thermometer tube will do), which is inserted so that its end projects a trifle into the chamber *A*.

The diaphragm, *D*, is made of sheet steel or brass, about .02 in. in thickness, and slightly cupped as shown. A gage point or hammer, *E*, is soldered to the center of this diaphragm, its end being slightly rounded. For this purpose use a 3/16-in. drill rod with its end slightly rounded and tempered. The diaphragm is soldered around its edge to the chamber face *A*.

The chamber of *A* is filled with mercury or alcohol, colored red and forced on to the spindle, *B*. The thermometer tube, *C*, is also filled with the same liquid so that when the part to be measured is placed between the hammer, *E*, and the anvil, *F*, any displacement or movement



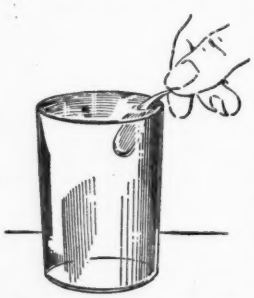
An ordinary micrometer fitted with a hydraulic hammer for efficient measurements

of *E* is transmitted to the diaphragm, which in turn acts on the liquid in the chamber, *A*, forcing it into the thermometer tube, where the variation can be seen.

The accuracy of this device depends on the diameter of the diaphragm, how well made and the size of the hole in the thermometer.—R. S. MYERS.

Shattering a Tumbler Without Touching It

PROCURE some Prince Rupert drops, drawn-out globules of molten glass, which have solidified in the form shown in the illustration. Your local druggist can supply you or they may be obtained from any scientific supply company.



Shattering a glass with a Prince Rupert drop

Then set a thin-walled tumbler full of water on a support, placed in a pan. Next, holding the Prince Rupert in the left hand, immerse the body of it in the water, and then with the right hand break off the tip of the projecting "pig tail." The walls of the tumbler will immediately be shattered and drop into the pan below.

The molecular forces in the glass drop just balance each other, but when the tip is broken off this balance is destroyed and the solid glass bursts.—FLOYD L. DARROW.

Wireless Work in Wartime

XII.—How the radio receiver works

By John V. L. Hogan

SINCE in the articles for the past few months we have studied various forms of spark transmitters for wireless telegraphy, and thus seen how radio waves are sent out from one station into the ether and along the earth's surface in all directions, we should now look into the ways and means available for receiving the messages. Remembering that the telegrams are spelled out letter by letter in groups of radio waves forming dots and dashes, it is easy to see that in order to write out the words of the message the operator at the receiving station must have some apparatus which is capable of intercepting the groups of radio waves as they pass by. This is the main purpose of the receiving apparatus.

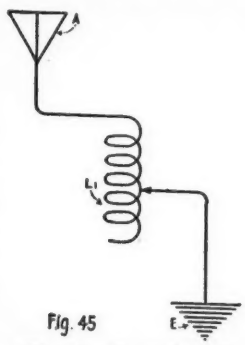


Fig. 45

The simple tuning of an antenna circuit

It is a useful property of the wireless waves that they will produce currents of whatever frequency they may have, in any conducting body which they strike. Thus, if we project into the air a system of wires arranged so that passing radio waves must strike them, we should expect the waves to set up radio-frequency currents in the wires. This is exactly what does happen at receiving stations; a number of aerial or antenna wires may be supported high in the air, by means of a mast, and connected to the earth through a variable inductance or tuning coil, as shown in Fig. 45. In this diagram the aerial is indicated by A, the earth by E, and the tuning coil by L_1.

Tuning the Antenna Circuit

The purpose of the tuning coil is to make the antenna-to-ground circuit adjustable to the condition which will result in securing the largest possible current from any particular desired radio wave. This result will generally be secured when the inductance of the coil is set at the value which makes the "natural frequency" of the aerial-to-ground circuit practically the same as the frequency of the radio waves; this is a condition of approximate or exact resonance, similar to that which is used at the transmitter, and merely indicates that the natural swings of current up and down the aerial-ground circuit occur at the right intervals to cooperate with the impulses set up by the waves. The addition of the two forces (i.e., that of the oscillating current previously produced in the antenna circuit, and that of the waves) going hand in hand results in the largest possible current flowing through the coil L_1.

Thus we have, in Fig. 45, a combination of apparatus which will give us a radio frequency current produced by the energy of passing radio frequency wireless waves. If the transmitter which is sending to us uses a 500-cycle alternator and a quenched gap properly adjusted, and is "tuned" to emit a wavelength of 600 meters, groups of waves having the wave frequency of 500,000 per second and separated by intervals of 1/1000 second will pass by our receiving aerial. These will set up groups of oscillations or high frequency alternating currents in our receiving system, the currents having the same wave frequency of 500,000 per second, and the groups occurring at the rate of 1,000 per second. No telegraph sounder or telephone receiver will give a direct indication which the operator can "read" if such high frequency currents are applied directly to it; and so some additional conversion of the signal energy is necessary before we can interpret the signals.

Increasing the Received Voltage

One of the best ways to apply the radio-frequency current energy to the converting device is to transform it to potential in a condenser. This may be done by adding the secondary circuit formed of the secondary coil L_2 and the condenser

C_1 which are shown in Fig. 46. It will be noted that the coil L_2 is placed near to the antenna circuit or primary coil L_1, so that the magnetic field of L_1 will induce currents in the secondary circuit by the coils' transformer action. Thus the groups of radio frequency currents set

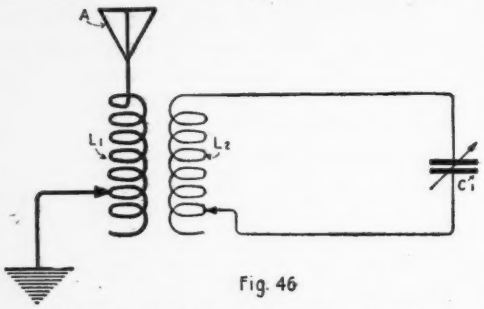


Fig. 46

Showing how the radio-frequency current is applied to the converting device

up in the antenna circuit by the arriving radio waves can now produce further groups of currents, of the same frequency, in the secondary circuit. In order to make the secondary currents as large as possible, the inductance of the coil L_2 and the capacity of the condenser C_1 are made variable; thus the "natural frequency" of the secondary is adjusted to agree practically with the frequency of the waves and of the tuned primary (or antenna) circuit, and, as in the other case, the cooperation of the two sets of currents pile up on the condenser C_1, in the form of radio frequency voltage; and hence, so long as each group of oscillations exists in the secondary circuit, the potential of the secondary condenser varies from positive to negative at the frequency of the waves. By making the coil L_2 of large size, while at the same time keeping the capacity of C_1 sufficiently small not to change the tuning condition (which depends upon the *product* of inductance and capacity multiplied together), the highest possible radio frequency voltages are secured from any particular radio wave.

Converting the Radio Currents

The secondary circuit contains currents and voltages which are still at the exceedingly high (and consequently inaudible) radio frequency of the waves, and which consequently cannot be used directly to produce signal tones from a telephone receiver. If, however, we complete the receiver by adding the instruments shown in Fig. 47, we can translate the dots and dashes made by the sending operator, into short and long tones which may be read as Morse characters. The three new elements are the detector D, the telephone condenser C_2, and the telephone receiver T, though in Fig. 47 the inductance of the aerial circuit is shown in two parts, L_1 or the primary coil itself being used to excite the secondary coil L_3, and the other portion L_3 being made variable and to tune the aerial circuit.

The detector D is shown as a "contact rectifier" of the kind represented by a piece of steel piano wire resting lightly on the surface of a galena crystal. This apparatus has the curious faculty of passing current easily in one direction but of offering an extremely high resistance to current which attempts to pass in the other direction. Consequently when the rapidly alternating voltages on the secondary condenser C_1 endeavor to force currents first one way and then the other, a substantial amount of electricity passes only in one direction. This "rectified" electricity charges the telephone condenser C_2 and then discharges back through the telephone windings, producing a movement of the telephone diaphragm. Since one charge of the condenser C_2 is generated for each group of radio waves, a transmitter of 1,000 sparks per

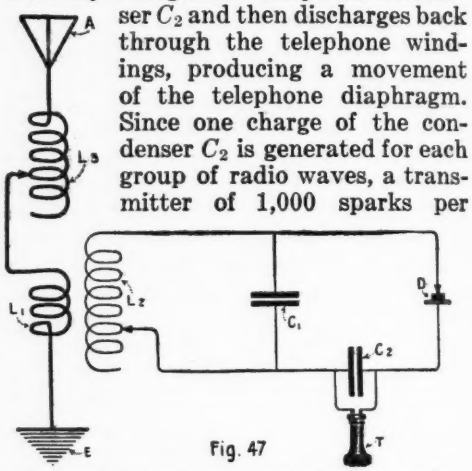


Fig. 47

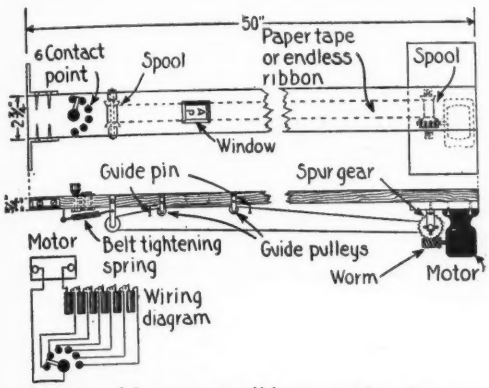
A complete hookup for a wireless telegraph receiver with aerial circuit in two parts

second will produce, at the receiver, 1,000 pulses of current through the telephone in each second. If these pulses occur uniformly, the telephone diaphragm will make 1,000 regular movements per second and a musical tone of the pitch 1,000 will be heard when the telephone is held to the ear.

(*To be continued*)

Telegraph Speed Practice with an Endless Ribbon

THE following scheme is one I recently designed to aid a young student of wireless telegraphy to work up speed in operating. It will adapt itself, however,



A motor-driven paper ribbon carrying characters for learning a code of any description

to a great variety of uses, such as learning a shorthand alphabet, a foreign-language vocabulary, typewriter keyboard, etc.

It consists of a wooden upright, in which is cut an opening just large enough to show one character at a time. On the back of this are four pins which serve to hold the moving ribbon in position, and two rollers to keep it close to the opening. The endless paper ribbon, on which the code is written or printed, is worm-driven by a small battery motor, over two wooden spools, one equipped with a spur gear, the other having a spring tension for the purpose of keeping the belt tight. A multipoint switch, which acts as a speed regulator, completes the apparatus.

The illustration gives the over-all dimensions rather than the specific ones, since the size of the device can readily be made to suit the individual requirements.—L. C. ARNOLD.

Save Hard Putty by Grinding and Making It Over

HARD putty can be made as good as new by simply putting it through a common household size food or meat grinder, using a fine cutter, and then mixing it with the proper proportion of oil to make it pliable.—E. M. THAYER.

Things to Know in Using a Hone and Strop to Sharpen Tools

AS a tool the razor will interest more men than any other tool known, not excepting the pocket knife. How to sharpen it is, therefore, a very vital matter. A good hone or stone is the first thing of importance. It must be neither too coarse and gritty nor too fine. It should have no flaws, though these are sometimes so minute that even an expert has difficulty in locating them. A good German stone is used by rubbing a smaller stone of the same kind on the face of the hone, with water, making a slight lather, on which the razor is worked, a few strokes usually being sufficient. As to quality, the stone costing the most will usually be the best.

Lay the razor perfectly flat on the stone diagonally, and draw the edge forward across the length of the stone. In nearly all cases of sharpening tools the edge is drawn or pushed forward, which prevents a wire edge as much as possible. Use a light pressure, reverse the razor with each stroke, turning it over on its back only. The condition and thickness of the razor will determine the number of strokes necessary, but in any case use as few as possible, stopping when you feel the smooth edge gone, though the edge should not feel wiry. The barber's rule is to use the hone little, but the strop more. The harm done by excessive honing can only be rectified by considerably more stropping than should be necessary. A stone may be used dry or with water or oil, as the stone may demand, the reason for using a liquid being to prevent the stone glazing.

The sharpening of safety razor blades is the same as the ordinary razor blade. To strop either form of blade hold it perfectly flat on the strop, holding the strap as rigidly as possible. Any slackness in the strop will cause the edge of the razor to become more or less bevelled. Draw the razor diagonally from heel to point, but never the reverse of this way. In the proper way the edge of the razor will not be drawn against its cutting edge, but away from it, the reverse of the honing operation. It is also important that the razor be drawn its full length with each stroke, from heel to toe. Strop

lightly. The four-square and also some two-sided strops have a coarse side which will make a good edge in the absence of a good stone. In fact, it is best to use this unless the razor is very round of cutting edge; a few strokes is all that will be necessary.

The strop hone is used dry, hence it is handy when you wish to give your razor a touch on it, when it is getting smooth on its edge. A drop of some non-drying oil should be applied to the strop at intervals, to keep it in good condition.

The oil stone must always be kept oiled and moist on its used surface, for if allowed to become dry and glazed it will get hard and unfit for use. Most new razor stones are better after being soaked in oil for a few days. Stones are usually sold with wood covers, to protect the surface from dust and from drying out. When you have finished using the oil stone rub a little oil over its surface and place it in its box.

Be careful in using the stone so that its surface will wear evenly. Turn the stone end for end, occasionally, and keep it clean by wiping the surface off with a clean cotton rag or cotton waste. If the stone has worn unevenly, make it level again with a piece of sandstone or emery brick. If the stone has become glazed or gummed up with oil, clean it off with ammonia or benzine. Never use turpentine or any non-drying oil on the stone. Excellent oils may be bought that are especially adapted for the purpose, but any oil that is used for sewing machines, typewriters, etc., will do.

For sharpening a pocket knife one may buy a stone that is made for the purpose, one that has just the proper amount of grit, is medium of grain, and that cuts fast enough without producing a wire edge. In sharpening a pocket knife the back is held slightly up, and the blade is drawn with an oblique motion, back and forth, rather quickly. The edge of the blade is drawn against the stone, not with it. Select a stone having the right grain, and it will give the knife a good edge. If there should be any rough edge it may be removed by a few strokes on the razor strop.

To sharpen a sloyd knife, which has a bevel embracing about one-half its width, lay it flat on the stone, like a razor, but do one side of the blade at a time, using the right and left hand alternately.

Many people sharpen a tool by working it on the stone in a rotary fashion, and this is not a good plan, as it is more apt to produce a wire edge. When a chisel is done this way it will make an uneven cutting edge. In any case, such a plan will cause more trouble in getting a fine edge. When sharpening a tool on a stone it is commonly drawn against the edge, but on a leather strap this of course cannot be done, without danger of cutting the leather.

In grinding a chisel or plane-bit on the grindstone keep the tool's edge firmly in one position, not permitting it to wander about. The idea is to get a slightly concave surface near the cutting edge, on the principle of the concave razor. Such an edge is easier to keep sharp and to resharpen. The emery wheels or those of corundum are furnished with a rest, which makes it easier to keep the tool in one position. When sharpening the tool on an oil stone hold it at the right angle, and in a diagonal position, not square with the stone. Almost always a mechanic, when sharpening a chisel or plane bit on a stone, will hold it square with the stone. Hold the tool firmly with both hands, drawing it back and forth, still in the diagonal position, but horizontally. It is important to hold the tool right, in order to get a true cutting edge. Reverse the position of the stone occasionally, and use the full face of it. When it has been sufficiently sharpened, turn it over and rub it lightly on the stone, to remove the slight roughness.

Chisels are made with angles adapted for working various woods—a slanting angle for a soft wood chisel, and a sharper angle for one used in hard wood. For a single-iron jack plane the bit should be slightly rounded; for common jack planes a little less rounded, while for smoothing, panel and trying planes the bit should be square, but the corners should be slightly rounded off. For all other bits have them exactly square.

To sharpen a gouge bit and other tools having an irregular edge, slightly rock it sideways as you push it back and forth on the stone. When grinding on the grindstone hold the bit at right angles with the stone, rocking the bit as you

grind it, in order that it may have a uniform bevel. Give the inside edge a few rubs with a round stone, to take away the wire edge.

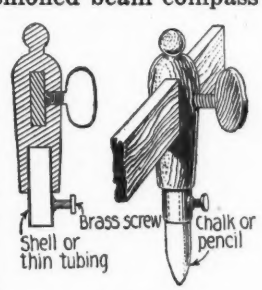
While most tools require to be ground with a smooth edge, the scythe and sickle demand the opposite—a rough, irregular edge; for a smooth edge would not catch and cut off the grass or grain. Thus the farmer pushes the stone away from him, over the edge of the blade. This gives the desired saw-tooth effect. When he sharpens the blade on the grindstone and starts cutting, he finds it necessary to give the edge a few strokes with his scythe stone, and then it cuts very much better.

The housewife sharpens her knife on an emery or corundum stick, usually by pushing the blade away from her. The right way is to draw the blade across the stick from heel to point, from end of stick to its heel, at a diagonal draw. It is not necessary to press very hard, as that injures the stick and does not make as good an edge on the knife. If a steel is used it should be a good one, or it will not sharpen the knife.

Shears and scissors should be left to the expert to grind. Sometimes a dull pair may be made to cut better for awhile by drawing the edges over one of the many devices sold for that purpose, but the result is seldom entirely satisfactory from any viewpoint.—A. ASHMUN KELLY.

Chalk Holder for Wood Workers' Beam Compasses

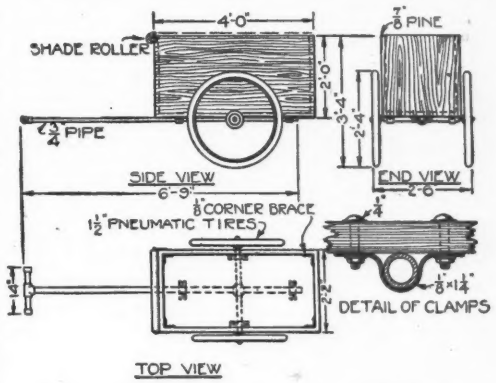
THE insertion of a brass rifle shell, sufficiently large to hold a piece of chalk, in an old-fashioned beam compass increases the efficiency of the instrument. A screw section from an old gas globe holder, soldered on, provides the fastening device. In this way pieces of colored chalk can be quickly inserted for different lines, and since chalk is used, it can be as quickly erased if a mistake is made. This obviates a deal of trouble for the amateur.



Converting a clothes-pin into a pencil holder

A Light Two-Wheeled Luggage Carrier for the Camper

FOR transporting your supplies from one camping place to another, or for a two-weeks' hike, a small two-wheeled, rubber-tired, weather-proof cart



A two-wheeled cart of light construction for carrying the camp duffle of a hunter

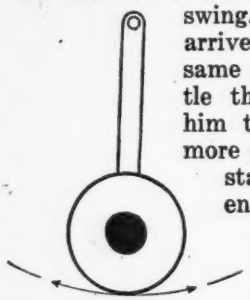
as shown, is very handy. The usual method of carrying a suit case filled with grub, cooking utensils, cartridges, moccasins, and all the other miscellaneous junk that campers are heir to, is entirely inadequate for the lone camper and sportsman, for he frequently finds a pleasant camping-ground and stays there a day or two, and then, when the spirit moves him, travels to another. The little hand car is a means of solving the problem.

The cart is constructed of two old bicycle wheels, iron pipe and a pine box for the body. The box is covered with a heavy window shade with its roller fastened to the front by the original hangers so that it may be drawn over the entire top and buttoned fast at the rear end to protect the contents against rain and dust. The tires should be kept inflated to a pressure of 40 or 45 lbs. and the axles well oiled.

On the outside of the body may be tacked or sewed several strips of leather belting, forming holsters for the hatchet, knife, lantern, etc. If the locality demands quick action, the gun or rifle may be carried where it can be snatched up in an instant. An old trunk strap slipped over the shoulder and handle makes an easy method of drawing the cart leaving the hands free to handle the gun when game is sighted.—P. P. AVERY.

The Swinging Target Is Not Difficult to Hit

IT is a strange thing that the novice will almost invariably try to hit the bull's-eye of a swinging target when it is at the center or in the lowest position. The expert knows better. He knows that the time to shoot is at the end of the swing. In fact, anyone will arrive ultimately at the same conclusion, for a little thought will convince him that a target is the more easily hit when at a standstill, or at the end of a vibration. The moving target as a rule has the largest bull's-eye, and is often one of the easiest to strike, if you happen to know how.

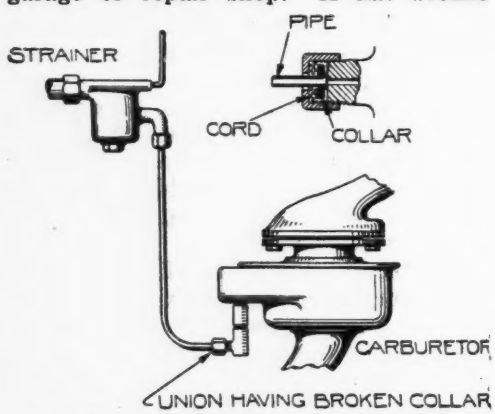


Don't aim at center of the swinging target

Simply aim at the point where the center of the target stops and wait till it returns. Then, bing! Your friend gives one of those sickly smiles and pays for the shots. Then he wastes another quarter trying to do something that he does not comprehend. "Simple if you only know how."—HAROLD C. RIDGELY.

Emergency Repair to a Broken Oil Pipe

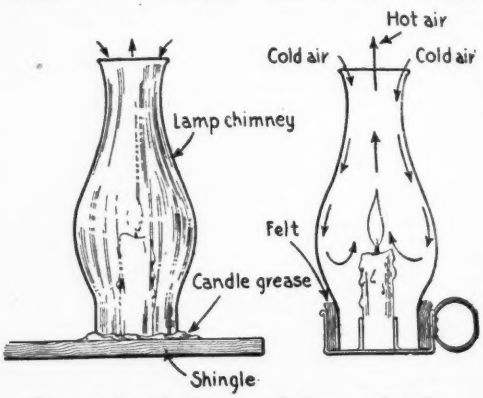
THE writer was recently out on a trip which ended several miles from any garage or repair shop. A flat bronze collar broke off the oil pipe next to the carbureter. The illustration shows how it was patched up to finish the trip. By means of a small punch found in the tool box, the pipe was flared to hold the collar, after which a few turns of light cord were wrapped behind it and drawn tight by means of the nut as it turned up. It afforded a perfectly tight joint and lasted until a new joint could be made in the shop, which could not be done until some days later.—F. W. BENTLEY, JR.



A modern method of joining a broken oil pipe to the carbureter of an automobile engine

A Simple Wind-Proof Lamp Used by Lumbermen

IN lumber camps a wind-proof candle-lamp is made by sticking the candle upright to a shingle with melted candle grease. A wind shield is made by placing a lamp-chimney over the candle as shown in the illustration and securing it air-tight to the shingle also by the melted candle grease. The supply of oxygen necessary to feed the candle flame is provided by currents of cold air which are drawn over the edge of the open top of the chimney and thence down, and close to the inner surface of the chimney to a point below the flame; the hot air from the flame passing upward and outward from the central parts of the open chimney top is protected from extinguishing wind currents, by the strong downward moving wall of cold air which rushes to replace the loss from combustion.

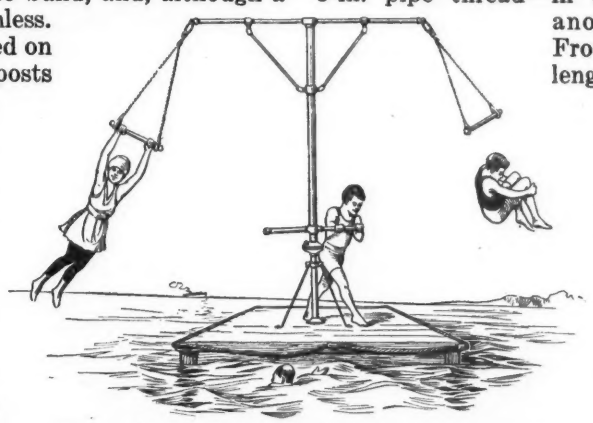


Two styles of a homemade lamp using the ordinary glass chimney with a candle

A practical embodiment of this principle is shown in the sectional view of the illustration, where the lamp-chimney base is supported within a cup-shaped candle-stick and the air seal is provided by an encircling band of felt. The novel principles of combustion and air replenishing currents are illustrated by arrows.

Centrifugal Whirler Offers a New Water Sport

A new, interesting sport at the seashore or lakeside always attracts the crowd. The "whirler" here described offers a distinct novelty in water sports, is comparatively easy to build, and, although a thriller, is harmless. It can be mounted on a raft or on posts driven into the ocean bed; in fact anything can be used for a support as long as the support is completely surrounded by water.



One active whirler furnishes the motive power while other participants in the game ride and dive

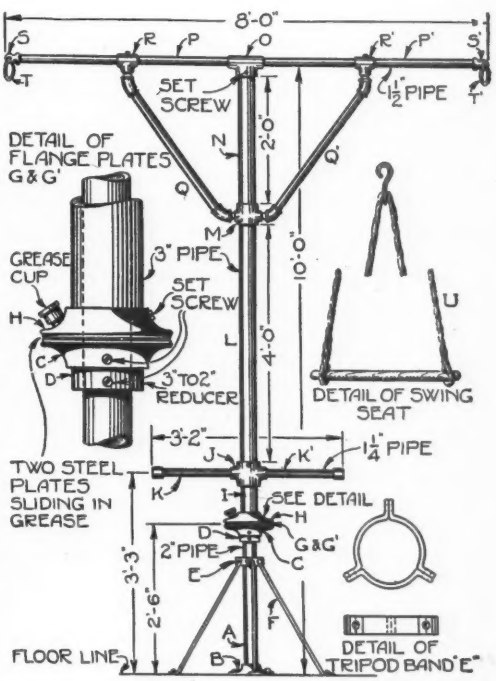
The main standard *A* is a 10-ft. length of 2-in. galvanized iron piping. This is firmly seated in a floor flange at the base, *B*. Another flange, *C*, with the face uppermost, is secured to *A* 2½ ft. from the floor. This flange should be for a 3-in. pipe and threaded to a short nipple, *D*, the whole of which is then slipped over *A* and held by means of set screws at the height mentioned.

The standard is supported in a vertical position by a tripod made of a band, *E*, and three legs, *F*. The band is made up of three separate strips of strap-iron; each with two lugs. These six lugs meet and form a circular band which fits snugly about *A*. The lugs are drilled to receive the three legs of round iron which are bolted in place; the other ends are bolted to the floor or platform.

The revolving spindle, *L*, is built up from the bottom as follows:

Have two polished steel plates or disks made with an inside diameter of 2½ in. and the outside diameter the same as the flange *C*. Slip these down upon *C* and then lay a corresponding flange, *H*, face down upon them. Fill the space between them with heavy grease which can always be replenished by a grease cup as shown. A nipple, *I*, of 3-in. pipe 6 in. long is then threaded into the flange, *H*, the top end supporting a four-way cross, *J*. Arrange to have the two side openings of the cross to take 1-in. pipe or otherwise reduce them to that size. These are to accommodate the handles *K* and *K'* made of 1½-ft. lengths of 1-in. pipe and capped at one end.

The main part *L* is a 4½-ft. length of 3-in. pipe thread—in the top of *J* to another cross *M*. From *M* rises a 2-ft. length of 3-in. pipe, *N*, to the tee, *O*. The total height of this revolving column may vary according to the depth that the sections are threaded together, but should be arranged so that the top of the tee, *O*, will clear the top of the inside standard *A* and the two flanges *C* and *H* will bear the complete weight of the column. The



Details of the parts for making the whirler to set on a float or dock at the beach

horizontal arms *P* and *P'* are 4-ft. lengths of 1½-in. piping. The outer ends are fitted with a cap and eye—*S* and *S'*. These are supported rigidly by means of the two braces *Q* and *Q'* connected to *M* by a 45 deg. el and nipple. The opposite ends are threaded to a tee in the same manner, which is large enough to act as a sliding sleeve over the arms. The top of each tee, *R* and *R'*, is tapped and fitted with a set screw to facilitate setting when the proper adjustment is found. Iron rings *I* and *I'* are passed through the eyes in the end caps *S* and *S'* and serve to hold the swinging seats *U*.

These swinging seats are a simple round wooden bar suspended from ropes as shown. They can be made adjustable in length by means of a buckle if desired. The average length should be enough to allow their being swung clear of the floor so they will not strike any obstructions.

When the bars, *K K'*, are turned rapidly the occupants of the seats are swung outward in proportion to the speed of the arms by centrifugal force.

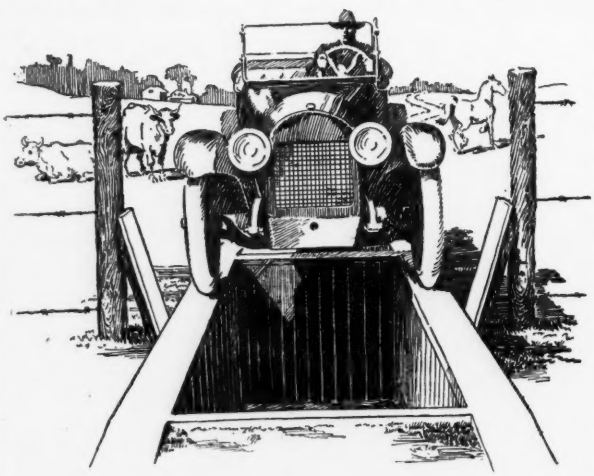
Spectacular jumps and dives into the water can be made according to the efficiency of the "crew."

A Heat Test That Shows the Quality of Wrought Iron

EVERY person who uses wrought iron for important parts of machines likes to know the quality of the metal he is using. By the simple test given in this article any workman can tell whether he is using first-class metal. Heat the bar to a cherry-red and plunge it into water heated to 82 deg. F. The bar is then bent cold around another bar of twice its own diameter or thickness. Good metal will not show any cracks or fissures at any point.

A Fence Stock Guard for an Automobile Road

IN a western community where a great many horses are raised there are many gates to open when traveling from place to place. When touring in an automobile, it was necessary to get out to open a gate and close it after passing through. As this took a great deal of time the owners of ranches built a guard, as shown in the illustration, to do away with the gates. The guard consists of a hole 4 ft. deep in the fence and two boards at the edge for the automobile wheels. The stock cannot pass through the opening and the automobile can be driven through without stopping to open and close the gates.—PAUL E. THOMAS.



A pit edged with boards for tracks in the opening of a fence for a stock guard and automobile gate

A Signal Light Connection for a Telephone Receiver

ON several occasions when an executive's assistant desired to converse with his superior the former was busy on the telephone, so he had to wait. To open the door every few minutes for the purpose of looking in or to have the operator notify you when the receiver has been hung up is both annoying and time-consuming. A private concern has installed an inexpensive device which eliminates this embarrassment. The executive's telephone has an extra connection which automatically lights a small blue light at the assistant's office when the former is using his phone. As soon as the executive hangs up the receiver the light goes out and the assistant knows that his superior is accessible. This device, which is very inexpensive, consists of two plates connected with wires which run through the cord to the assistant's office.